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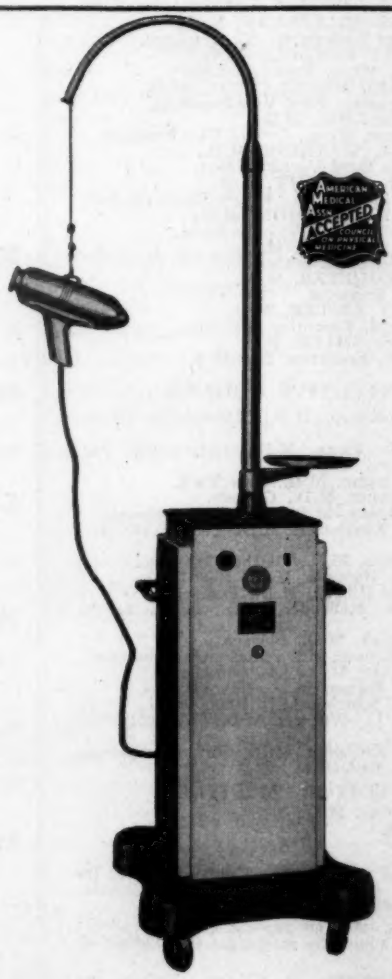

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THE EVALUATION OF DISABILITY AND TREATMENT IN HEMIPLEGIA *

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DENVER

The hemiplegic patient has always presented a difficult problem in management, both to the internist and to the physiatrist. Rapid and extensive advances have been made in the fields of preventive medicine (the first phase of medicine) and in the second phase of medicine, diagnosis and treatment. As a result, the life expectancy and the general age level of the population has gradually increased, and this trend may be expected to continue for some time. The disabilities of later life, such as cerebral vascular accident, have thus become more frequent and have assumed an increasingly prominent place in the practice of medicine, particularly in physical medicine and rehabilitation, the third phase of medicine.

Much has been written on the clinical observations, the differential diagnoses and the pathologic changes of cerebrovascular lesions. A review of the literature reveals relatively few studies concerning the treatment of patients with these disabilities or the factors which influence their survival and recovery.

This paper is presented as a preliminary study in the evaluation of the hemiplegic patient. A method of evaluation of the disability will be presented, followed by an analysis of the cases of 50 consecutive patients with hemiplegia referred for physical treatment and rehabilitation to the department of physical medicine of Bellevue Hospital, New York, between September, 1945 and March, 1946. An attempt will be made to present a review of the literature pertinent to the topic under discussion.

Volitional movement in man represents a highly complex activity of the neuromuscular system. The anatomic and physiologic mechanisms involved are incompletely understood. Hence, many basic factors related to complex motor dysfunction, such as occur in the hemiplegic patient, remain undetermined.

From the viewpoint of histologic structure, distribution and physiologic activity, it is difficult to continue to regard the giant cells of Betz as a specific entity and as sole originators of the pyramidal tracts. Rather, it would appear that they represent the largest in the series of transitional pyramidal cells. The agranular frontal cortex of areas 4 and 6 (Brodmann), (FA and FB) is characterized by the presence of these pyramidal cells, which reach their greatest development in layers III and V, the Betz cells being mostly restricted to layer V.

Much controversy still exists as to the identity of the "motor cortex." Walshe,[1] in reviewing the available information, expressed the belief that the "motor cortex" is a single, inseparable anatomic and physiologic unit embracing the whole of area 4 (FA) and the adjacent posterior portion of 6 (FB). He feels that the division into pyramidal and extrapyramidal sys-

* This study was undertaken and completed while I was a Baruch Fellow in Physical Medicine, Department of Physical Medicine, New York University College of Medicine.
* Read at the Twenty-Fourth Annual Session, American Congress of Physical Medicine, New York, Sept. 6, 1946.

1. Walshe, F. M. R.: Brain 65:409 (Dec.) 1942.

tems, "motor and premotor areas," as advocated by Fulton and others, is not justifiable on the basis of available data. This problem bears directly on the question of the production of spasticity and flaccidity in man, the mechanism of which still remains a moot question.

The unsolved problems of the motor cortex and the pyramidal tracts must be further complicated by the correlation of the role of the collateral systems which undoubtedly play a prominent role in human motor function and dysfunction in man. These include the thalamus, basal ganglions, cerebellum, premotor cortex and their associated commissural and crossed pathways and spinal projections.[2]

On the basis of evidence adduced, it is probable that individual muscles are represented in the "motor cortex" and that "movements" are represented in the larger cerebral organization of the frontal lobe. It is apparent that function is not merely a matter of nerve cells or bodies or pathways but is rather an extremely complex correlated anatomicophysiologic process set up at neural synapses. Reciprocal innervation in every movement is elicited by cortical stimulation, and in the hemiplegic person the paralysis of a muscle as such is never seen, only a paralysis of "movement."

Sudden death from cerebrovascular accident is the exception rather than the rule. In one study,[3] it was noted that the average survival period after thrombosis was approximately fifteen times as long as that following hemorrhage or embolism. The survival period was greater among white persons than among Negroes (this difference was mainly confined to patients with cerebral thrombosis). The maximum survival period occurred among the 30 to 40 year age group and was greater in females than in males. It was felt that other factors influencing survival were the size, location and number of lesions involved.

In a group of 120 patients with cerebral hemorrhage admitted to the Henry Ford Hospital between 1934 and 1939, hypertension and arteriosclerosis were noted as the chief etiologic factors. It was found that the prognosis was dependent on the presence or absence of associated pathologic states, such as chronic nephritis, diabetes, syphilis, toxemia of pregnancy, brain tumor, hyperthyroidism, rheumatic heart disease and polycythemia. If such allied etiologic factors were present, the mortality was 57 per cent; if absent, 32 per cent. The prognosis was also found to be dependent on the presence and number of previous "strokes."

The patient with a flaccid hemiplegia is severely crippled. In a study[4] of 10 patients with prolonged flaccidity, 2 regained the ability to walk, the others remained bedfast or were confined to bed until death. It was felt that Verhaart's opinion that prolonged flaccidity is a poor prognostic sign as far as recovery of movement is concerned is probably valid.

Walshe, cited by Ford,[5] has shown that the hemiplegic posture is an exaggeration of our normal standing posture. From the physiologic point of view, hemiplegia has a close relationship to decerebrate rigidity in the experimental animal. Neurons of the central nervous system cannot regenerate. Destruction of a neural pathway must therefore result in irreparable damage. Yet it has been observed that the patient's condition improves to a varying degree. This is considered by some to be attributed, in the early phase of recovery, to the disappearance of so-called "neurologic shock." In the second phase, which lasts longer and during which recovery is slower, it may be due to what Hughlings Jackson has called "compensation." He has

2. Minckler, J., and Klemme, R. M.: Proc. Soc. Exp. Biol. & Med. 53:264 (June) 1943. Cobb, S.: Bull. N. Y. Acad. Med. 19:34 (Jan.) 1943.
3. Newbill, H. P.: J. A. M. A. 114:236 (Jan.) 1940.
4. Aring, C. D.: Arch. Neurol. & Psychiat. 43:302 (Feb.) 1940.
5. Ford, F. R.: M. Clin. N. Amer. 21:1523-1536 (Sept.) 1937.

expressed the belief that the movements of each side of the body are represented in both hemispheres, although to a different dgree.

It has been experimentally demonstrated[6] that the rate of recovery from lesions of the central nervous system can be materially increased by medication, since strychnine, thiamine and Doryl (a cholinergic drug) have all been found to increase recovery.

Goldstein has questioned the existence of vicarious function. He claims that "a true recovery of function comes only as a result of restoration of the anatomical cortical substratum, or under exceedingly rare and limited conditions, by a tedious process of relearning with the help of a remnant of the substratum which participated in the original function." On the other hand, most workers have stressed the plasticity of the organization of the central nervous system, implying that the capacity for genuine restitution of function is always present.

It has been postulated by several investigators that the recovery of function following cortical lesions is due to some form of "functional reorganization" of the remaining cerebral tissue. There has been extensive work done in the field of neurophysiology in an attempt to throw some light on the mechanism by which such a "functional reorganization" takes place. How much of it is due to a process of synaptic modification, neurochemical processes or conditioning and relearning remains a moot question.

Additional mechanisms, of an even more intangible nature, play a role in the complex process of restitution and recovery of function in the hemiplegic person. The occurrence of "imperception of disease"[7] has frequently been mentioned in connection with such syndromes as blindness, the various aphasias, finger agnosia and phantom limb. Babinski termed this "imperception of disease" in hemiplegia "anosognosia." It occurs not infrequently in persons with left hemiplegia and is associated with a lack of recognition of the paralysis or with a neglect of impressions from the involved parts or side of the body. Gerstman[7a] related this syndrome with the concept of the so-called body scheme or body image, as elaborated by Pick, Head and Schilder. It is felt that the body scheme represents a picture or inner diagram of the body which the individual forms in his own mind. It relates to such things as location of the body parts, their size, structure and function and their spatial interrelationships. Tactile, kinesthetic and optic experiences, and probably other receptive factors, all contribute to orient the body in space and in its relation to external objects. Evidence indicates that either lesions involving the major hemisphere in the region of the parietal or parieto-occipital region or lesions in the minor hemisphere that disturb the commisural and associational fibers which correlate the two hemispheres may produce this syndrome.

Although complex motor dysfunction is peculiarly human and is not particularly related to similar states in lower animals, experimental work has indicated[8] that cerebral damage in cats, dogs and monkeys raises similar problems. Kennard[9] has demonstrated that ablation of areas 4 and 6 in the young normal monkey has little effect on skilled motor acts, owing to a reorganization of function in the remaining areas of the cortex (probably prefrontal area and postcentral gyrus). He concludes that whatever the process behind reorganization of the cortex, whether it be physiologic, related to learning or anatomic and related to growth of dendrites or synaptic modifications, it is probable that the factors which facilitate cortical reorganization

6. Ward, A. A., Jr., and Kennard, M. A.: Yale J. Biol. & Med. 15:189 (Dec.) 1942.
7. (*a*) Gerstman, J.: Arch. Neurol. & Psychiat. 48:890 (Dec.) 1942. (*b*) Spillane, J. D.: Lancet 1:42 (Jan.) 1942. (*c*) Weber, F. P.: ibid. 1:44 (Jan.) 1942.
8. Kabat, H.; Dennis, C., and Baker, A. B.: Am. J. Physiol. 132:737 (April) 1941.
9. Kennard, M. A.: Arch. Neurol. & Psychiat. 48:227 (Aug.) 1942.

in the normal young are the same as those by which reorganization is accomplished in the imperfect cortex after injury or disease.

It has been noted[10] that there are variations in the degree of instability produced with cerebral lesions. The instability relates, basically, to a physiologic element associated with lesions of this type. The physiologic element, in turn, is regularly magnified and extended by the emotional factors involved. Dr. Kurt Goldstein, among others, has expressed the opinion that there is a basic, constant personality defect underlying the various clinical pictures associated with cerebral lesions.

Material from 1,000 cases[11] cerebrovascular lesions in which necropsy was done at the Los Angeles General Hospital between March, 1918 and November, 1934 revealed a variety of "psychotic manifestations." These could be classified into four groups:

(*a*) Confusion with irritability — severe.
(*b*) Delirious states — noisy, manic-like or lethargic.
(*c*) Delusional or hallucinatory trends, with or without belligerence or other abnormal behavior.
(*d*) Established defects of judgment and memory indicating mental deterioration.

These psychotic phenomena were noted in 170, or 17 per cent, of the 1,000 cases reported.

Evaluation and Testing

It has been my experience that most programs of physical treatment and rehabilitation for the hemiplegic patient have been instituted on a basis of observation and empiricism. It is my firm conviction that, in order to place treatment judiciously or to arrive at any reliable conclusions as to the extent of the disability and the process of recovery, such programs must be based on objective methods of testing and evaluation. Only through such methods can one accurately analyze the factors influencing recovery and institute a program of physical treatment and reeducation adequate to meet the patient's needs. A method of evaluation and treatment is, therefore, presented.

When definitive medical treatment has ceased, the physician in physical medicine is called in consultation to institute a program of physical treatment which will hasten the recovery of the hemiplegic patient. The two problems that have immediately presented themselves have been as follows: 1. What is the extent of the patient's disability? How far along the road to recovery is he? 2. What can the patient do with his disability?

In order to determine the answers to these questions, the following methods of testing and evaluation have been devised and employed: (1) motor ability test and (2) test of the factors inherent in daily living.[12]

The Motor Ability Test. — A muscle or muscle group involved in a specific movement is graded according to a scale with twelve gradations of muscle strength. Unit values, which are referred to as "units of motor function," have been assigned to each of these gradations (table 1).

Since the motor ability test involves twenty movements in an upper extremity, the score will vary from 0 units of motor function in complete flaccid paralysis of 240 units (20×12) for a normal upper extremity.

In the lower extremity, with fifteen movements involved the score will vary from 0 to 180 (15×12) units of motor function. The range of motion

10. Balford, L.: Psychosom. Med. 5:15 (Jan.) 1943.
11. Irish, C. W.: Am. J. Psychiat. 96:897 (Jan.) 1940.
12. Deaver, G. G., and Brown, M. E.: Physical Demands of Daily Life, New York, Inst. for the Crippled and Disabled, 1945.

in degrees is determined passively at the same time as the motor ability test is performed. Thus it is a relatively simple matter to determine, at any given testing, the percentage of normal motor function presented by a given upper and lower extremity of the hemiplegic or hemiparetic patient.

TABLE 1. — *Method of Scoring Units of Motor Function.*

Grade	Units
0	0
Trace	1
Trace +	2
Poor —	3
Poor	4
Poor +	5
Fair —	6
Fair	7
Fair +	8
Good —	9
Good	10
Good +	11
Normal	12

CASE 1. — M. K., a 42 year old white man, was admitted to the Medical Service at Bellevue Hospital, presenting the picture of a complete flaccid right paralysis, aphasia and some degree of emotional liability, on the basis of an extensive cerebral thrombosis. Six days after the onset of his "accident" I saw the patient in consultation, and testing revealed a score of 10 units of motor function in the right arm and 37 units in the right leg. In other words, the patient exhibited 4 per cent motor function in the upper and 20 per cent function in the lower extremity. Subsequent testing revealed 18 per cent function in the upper and 46 per cent in the involved lower extremity. On Dec. 12, 1945, ten weeks following the onset of the illness, there was revealed a return of 33 per cent motor function in the right upper and 61 per cent in the right lower extremity. The flaccidity had changed to spasticity in the involved members. As noted in the range of motion testing, in the short time between onset of the illness and the institution of physical prescription the right shoulder joint was limited to 90 degrees of abduction.

CASE 2. — N. Q., a 76 year old white female, was admitted presenting the clinical picture of a residual left spastic hemiparesis, due to a cerebral hemorrhage (onset six weeks earlier). At the end of eight weeks of her illness, testing revealed the presence of 78 per cent motor function in the left upper extremity and 86 per cent of normal function in the left lower extremity, with limitation in range of motion at the left shoulder in abduction and external rotation.

The determination of the degree of return of motor function is, in itself, not adequate as a guide in planning therapy. On the basis of observation alone it has been evident that hemiplegic patients vary in their ability to perform activities in spite of similar motor status. Therefore, after the ability motor test has been given, preferably on the same day, the patient is given a test of the factors inherent in daily living (table 2). In a specially equipped testing room, in the department of physical medicine, the patient is asked to perform sixty different activities which might be required of him in everyday life.

There are twenty-two activities involving locomotion and traveling, eight involving dressing, seven involving toilet activities, eight involving eating and fifteen involving the hands involved in the performance of this functional test. Each activity is graded and scored (table 3) and summarized graphically.

It becomes evident that patient M. K. (case 1) improved only 5 per cent in functional testing, although motor activity improved 29 per cent and 41 per cent in upper and lower extremities, respectively.

TABLE 2. — *Test of Activities Inherent in Daily Living.*

Patient M. K.	Grading	Score
"N"	denotes that the activity is normal in methods used and length of time required to perform it.	N — 3
"X"	denotes that the activity, though not normal, is adequate to present needs.	X — 2
"XX"	denotes that the activity, though not normal, is possible but very slow, labored or unsteady.	XX — 1
"O"	denotes that the activity is impossible.	0 — 0
"V"	denotes that the activity, not being normal, can be improved.	
"—"	denotes that testing the activity is not indicated.	

TABLE 3. — *Test of Activities Inherent in Daily Living.*

Patient: M. K. Side: R V L Type: Sp. Fl. V

Activity	No. Items	Normal Score	10/10/45 Score	11/7/45 Score	12/11/45 Score	1/5/46 Score
1. Locomotion and traveling	22	66	14	14	17	24
2. Dressing						
Activities						
Appliances						
Yes No	8	24	6	6	6	6
3. Toilet activities	7	21	13	14	14	13
4. Eating activities	8	24	10	10	10	11
5. Hand activities	15	45	17	17	17	17
	—	—	—	—	—	—
Total	60	180	60	61	64	71

TABLE 4. — *Test of Activities Inherent in Daily Living.*

Patient: N. Q. Side: R L V Type: Sp. V Fl.

Activity	No. Items	Normal Score	10/31/45 Score	11/27/45 Score	1/3/46 Score
1. Locomotion and traveling	22	66	0	0	0
2. Dressing					
Activities					
Appliances					
Yes No	8	24	8	8	10
3. Toilet activities	7	21	11	12	12
4. Eating activities	8	24	9	13	12
5. Hand activities	15	45	20	26	26
	—	—	—	—	60
Total	60	180	48	59	60

Comments: Depressive state. Does not make much of an attempt to walk. Has peripheral facial palsy on left. Has been rather ill for ten days preceding last testing.

Patient N. Q. (case 2) attained a score of 60 or 30 per cent in functional testing whereas her motor ability tests indicated the presence of 78 per cent and 86 per cent of normal in motor strength in the upper and lower extremities, respectively. Inspection of table 4 makes it apparent that N. Q. scored 0 on all activities involving locomotion and traveling. She could not walk, in spite of a score of 86 per cent of motor function in the lower extremity. A psychiatric consultation was requested on the basis of these findings, and it was noted that the patient was suffering from a "depressive state" and did not want to walk. With proper guidance and motivation she is now up and about and ready for discharge.

Analysis of Results: Tables 5, 6, 7

Treatment: The purposes of physical treatment and rehabilitation are (*a*) to prevent and correct deformities, (*b*) to increase muscle function and (*c*) to teach the patient to perform activities essential to daily living. Experience gained in the care of the disabled indicates that the basic requirement of any program of physical treatment and rehabilitation should be the development of self reliance. Unless this is considered, the treatment will be inadequate to meet the patient's needs. They are the following: (1) Ability to walk and travel; (2) ability to take care of personal needs; (3) ability to do hand activities.

Based on the analysis of the motor ability test and the test of factors inherent in daily living, a program of physical treatment is instituted. As the individual patient may require, any or all of the following measures may be employed:

1. Passive exercises
2. Electrotherapy
3. Massage
4. Muscle reeducation
   (*a*) Walking reeducation
5. Appliances
6. Pulley exercises
7. Occupational therapy
   (*b*) Hand activities
   (*b*) Functional activities
   (*c*) Diversional activities

1. *Passive Exercises.* — These should be begun at the earliest possible moment. This is especially true in cases in which flaccidity is prolonged and function is slow in returning. The therapist, working at the bedside daily, induces passively a few movements, through normal range of all joints in the involved members. Thus the pronounced tendency of the hemiplegic person toward development of contractures (at the shoulder joint especially in abduction) will be minimized or eliminated. Passive exercises may also be indicated in attempting to overcome mild deformities resulting from the pull of spastic muscle groups against weakened or flaccid antagonists. This daily contact between therapist and patient also serves to gain the patient's confidence and cooperation, both of which are needed in carrying through a long, detailed program of therapy.

2. *Electrotherapy.* — It remains true that muscle strength and body can be developed only through active exercise. However, there is considerable experimental work to indicate that daily galvanic or faradic stimulation of denervated muscle serves to maintain muscle tone and weight. It is suggested that muscle groups so treated following reinnervation are more easily developed and strengthened. In the group of hemiplegic patients who exhibit prolonged flaccidity, although the mechanism is not the same as that in persons with lower motor neuron lesions, electrical stimulation may be a valuable therapeutic adjunct in maintaining tone and minimizing atrophy. If a contraction can be obtained, it becomes, in addition, a factor in the program of muscle or movement reeducation.

3. *Pulley Exercises.* — Pulley exercises serve two extremely important functions in the treatment of the hemiplegic patient. First, they represent an efficient method of preventing the formation of contractures or adhesions of joints and of increasing the range of motion when they do occur As previously noted, a condition commonly observed in persons with this type of disabilities, particularly when treatment has been withheld for some time, is the so-called frozen shoulder. Range of motion in all directions at the

TABLE 5. — *Analysis of Results.*

1. Total number of patients		50	100%
2. Male		32	64%
Female		18	36%
3. Right Sided Disabilities		27	54%
Left Sided Disabilities		23	46%
4. Males — Right-sided disabilities		16	50%
Females — Right-sided disabilities		10	43%
Males — Left-sided disabilities		16	50%
Females — Left-sided disabilities		13	57%
5. Color — White		39	78%
Black		8	16%
Yellow		3	6%
6. Age — Over-all		41-78 yr.	Av. 62.4 yrs.
	Male	-	Av. 59.8 yrs.
	Female		Av. 63.3 yrs.
7. Etiology — Embolus		0	0
Thrombus		26	52%
Hemhorrage		11	22%
Not established		13	26%

TABLE 6. — *Analysis of Results Chart.*

8. Associated conditions			
	Hypertension	7	14%
	Arteriosclerosis	7	14%
	Ascl. and Hyp.	31	62%
	Diabetes & Ascl. & Hyp.	3	6%
	CNS Lues & Ascl. & Hyp.	2	4%
9. Duration of hemiplegia before physical therapy instituted		Limits 2 days to 5 years	Av. 20.7 wks.
10. Facial involvement — aphasia		27 patients	54%
11. Emotional liability or psychotic manifest		10 patients	20%
12. Previous strokes		3 patients	6%
13. Residual speech difficulty		9 patients	18%
14. Able to walk on admission		8 patients	16%
15. Able to walk on discharge		47 patients	94%
16. Required use of appliance, brace, cane		12 patients	24%
17. Length of time in department		Limits 7 days to 5 months	Av. 6.1 wks.

TABLE 7. — *Analysis of Results Chart.*

18. Functional capacity as compared to motor power			
	Equal in	5 patients	10%
	Greater in	3 patients	
	Less in	42 patients	84%
19. Return of Motor Power in Lower Extremity as compared to Upper			
	(*a*) Equal in	11 patients	22%
	(*b*) Less in	4 patients	8%
	(*c*) Greater in	35 patients	70%
20. In 19 (*c*)% difference in motor strength between lower and upper extremities, ranged from		2 to 80% greater	Av. 11.6%
21. Return of functional capacity as indicated by D. Act. Test, greater than 50% of norm		17 patients	34%
22. Permanent flaccidity observed in		0 patients	0
Spasticity eventually noted in		50 patients	100%
23. Movement and Strength returned sooner in proximal than in distal segments in		41 patients	82%
24. Greatest limitation of range noted at and greatest in patients having longest delay in instituting physical therapy		Shoulder joint	

shoulder joint becomes noticeably limited, and the joint is often painful on manipulation. The patient develops a reflex "protective spasm" of the shoulder girdle musculature and actively resists the therapist's attempt to go beyond the range which induces pain. However, if the patient does the stretching himself, through use of the pulley apparatus, it has been my observation that the increase of range of motion is much greater. Since the patient feels that some one is not going to hurt him and he has complete responsibility for carrying through the movement, an additional increment of 10 to 15 per cent of motion is not uncommonly gained. Placing the responsibility of treatment on the patient is an important value of this form of therapy.

Secondly, I feel that pulley exercises, by offering an opportunity for reciprocal motion, are an important phase of the process of relearning. Frequently, such reciprocal motion gives the initial impetus in the program of movement reeducation. It serves to establish awareness of corticomuscular pathways and movement patterns that have not been employed by the patient for some time. It is important to carry over this concept of reciprocal motion in the program of muscle reeducation as motor function returns to the previously flaccid extremity.

4. *Occupational Therapy.* — This is an invaluable aid in the program of relearning. This statement holds true, however, only if the activities instituted are of a functional rather than of a purely diversional nature. Such activities must be selected on the basis of the patient's needs, as evidenced by the procedure in the test of factors inherent in daily living. For example, if the patient cannot tie his shoestrings, get up a curb, cut meat with a knife and fork, etc., teaching him to accomplish these activities becomes his program of occupational therapy. Such treatment serves also to motivate the patient to greater effort and maintain his morale at a higher level than any amount of diversional activity that may be offered in the conventional employment of the arts and crafts.

5. *Appliances.* — Appliances are frequently indicated in the management of the hemiplegic patient. It may be necessary to employ a short leg brace, with a 90 degree stop at the ankle, to correct a foot drop and to provide adequate locomotion. The proper use of crutches or canes in the process of walking reeducation is extremely important.

As flaccidity disappears and spasticity supervenes, muscle imbalance becomes an important problem. Finger flexion, for example, returns first and tends to overcome the action of the weaker antagonist group, the finger extensors. When such a situation exists, it becomes necessary to apply a splint or anterior molded plaster to prevent flexion contracture deformity of the digits. Attention to details such as these in the management of the hemiplegic patient will insure a quickened, adequate return of activity wherever possible.

In the over-all plan of treatment, my colleagues and I have followed certain axiomatic principles:

1. Treatment should be instituted as early as possible, as soon as definitive medical treatment has ceased.

2. As early as practicable one should strive to establish a self care for the patient. Patients soon learn that being waited on is an extremely pleasant experience. They develop a sense of well-being that makes their rehabilitation more difficult as time goes by.

3. If the quadriceps has acquired good power and there is adequate stability at the knee joint, the patient should be got up and started on a program of walking reeducation.

4. If flaccidity persists, an attempt should be made to motivate him to sit up in bed and take care of as many of his own needs as possible.

5. Since function in the lower extremity returns before that in the upper extremity, one should concentrate on locomotion and traveling activities first. In this way, earlier discharge from the hospital will be possible and the program of hand activities can be instituted on an outpatient basis.

6. Better results are obtained by working with the patient than by working on him.

7. The program of therapy should be extended as far into the day as is possible within the patient's limits. One should remember the "3 A Rule:" "Action Absorbs Anxiety."

Summary and Conclusions

An objective method of testing motor strength, range of motion and functional capacity is presented as a guide to the evaluation of disability in the hemiplegic patient.

A review of the literature relating to the problem of recovery is presented.

Based upon the material and results presented the following conclusions are reached:

1. Physical treatment and rehabilitation of the hemiplegic patient should be instituted as early as possible, as soon as definitive medical treatment has ceased.

The program of treatment in each case should be individualized and instituted on the basis of the evaluation of the disability as determined by objective testing.

3. Treatment of the patient must be sufficiently adequate to enable him to cope with the demands of daily living.

4. Since in the great majority of cases the lower extremity recovers first and to a greater degree, early treatment should aim to make the patient ambulatory. Further treatment and rehabilitation may then be carried out on an outpatient basis.

5. Basically, the prognosis as to return of function will depend on the nature, size and location of the lesion.

6. Age, sex and side on which the lesions are located do not in themselves affect recovery.

.7 Recovery will be affected adversely by such manifestations as prolonged flaccidity, severe emotional disturbance, lack of motivation or the will to do and the presence of associated pathologic conditions or progressive diseases which nullify the gains of rehabilitation.

8. Recovery of motor ability does not correlate well with the return of functional capacity in the hemiplegic patient. As a rule, the latter returns to a lower degree than the former.

9. The careful evaluation of the extent of disability and the return of function may be used as a guide in the vocational and psychosocial guidance and retraining of the patient.

Although a parallel control series was not conducted, observation of a considerable number of hemiplegic patients not receiving an organized program of rehabilitation and retraining has led me to believe that with a properly conducted and adequate program in the third phase of therapy for hemiplegic patients the recovered functional capacity is definitely increased.

It is hoped that this preliminary study, on this relatively small group of hemiplegic patients, will stimulate further investigation in both measured evaluation and therapy in this important disabling condition.

A SURVEY METHOD FOR RADIATION COVERAGE PATTERNS OF INFRA-RED GENERATORS *

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IOWA CITY

Purposes of the Study

Since quantitative dosage methods enable the prediction of results in therapy, and so permit planning of therapy procedures and help make comparison of the treatment data of many persons in the same field simpler, this study was undertaken for an infra-red therapy problem that is now significant in the large scale quantitative evolution,[1] gaining way in the practice of physical medicine.

How well infra-red generators cover the treatment area at which they are directed is of considerable importance to careful and genuinely successful therapeutic practice with infra-red radiation.

Many workers have realized the importance of this therapeutic question, and in the United States such people as Earl Elkins, R. H. Maxon, H. J. Holmquest, Clifton B. Cosby and C. B. Braestrup have pioneered personal physical measurement studies of the coverage of infra-red sources for the various generators in which they were directly interested.

In Great Britain W. V. Mayneord and T. J. Tulley,[2] as well as D. S. Evans and K. Mendelssohn,[3] have reported careful physical studies made with some lamps and cradles in clinical use at their establishments.

Following along the line set by the investigators named here, it has seemed of definite importance to establish further information in addition to that already gathered in this field for the following reasons: (1) to add to the general efficiency of infra-red therapy procedures; (2) to clarify the present status of coverage patterns produced by infra-red generator equipment; (3) to add significance and validity to physical dosage measurements of radiation intensity in this area of physical medicine; (4) to help make possible regular, quantitative prescription of infra-red radiation used in physical medicine therapy procedures.

The regular operation of one or two laboratories making observations of this kind should, in a period of about two years, enable complete data to be gathered on existing types of American infra-red therapy lamps. Surveys of this kind can, at all times, help new lamp development.

* From the Department of Physiology and the Department of Physical Medicine, College of Medicine, State University of Iowa.
* This study was made possible by research grants from the Baruch Committee on Physical Medicine in New York City, and from Burdick Corporation of Milton, Wis.
* Read at the Twenty-Fourth Annual Session, American Congress of Physical Medicine, New York, Sept. 6, 1946.
** Now Chief Biophysicist, Climatic Research Laboratory, U. S. Q. M. C., Lawrence, Mass.
1. Piersol, George Morris: Functions of a Center for Instruction and Research in Physical Medicine, Arch. Phys. Med. 26:133 (March) 1945. Krusen, Frank H.: The Expanding Field of Physical Medicine, Proc. Staff Meet., Mayo Clin. 20:497 (Dec. 26) 1945. Lion, K. S.: Technology and Medicine, Arch. Phys. Med. 27:279 (May) 1946.
2. Mayneord, W. V., and Tulley, T. J.: The Measurement of Non-Ionizing Radiations for Medical Purposes, Proc. Roy. Soc. Med. 36:411 (April 14) 1943.
3. Evans, D. S., and Mendelssohn, K.: Estimation of Heat Radiation in Clinical Practice, Brit. M. J. 2:811 (Dec. 23) 1944. Evans, D. S., and Mendelssohn, K.: The Physical Basis of Radiant Heat Therapy, Proc. Roy. Soc. Med. 38:578 (Aug.) 1945.

The Survey Method

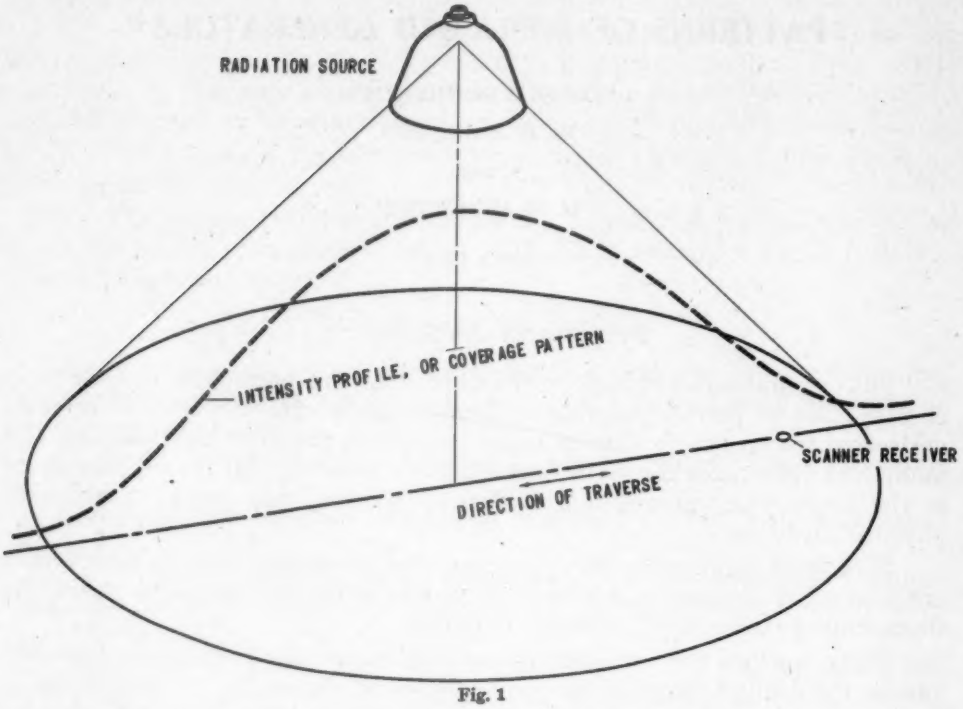


Fig. 1

Figure 1 shows the way in which a coverage pattern is made in this study. A quantitative measurement is made of the physical infra-red illumination of a plane which is presented at right angles to the central axis of an infra-red lamp source.

In essence, an automatically recorded plot is made of a radiation-intensity profile, called a coverage pattern, which shows the relative infra-red intensities existing along a straight-line traverse made across the illuminated plane, and thus gives a picture of the way in which the infra-red source is covering the area at whch it is being aimed.

This procedure gives a rapid and definitive description of the coverage characteristics of the particular lamp being studied. Where it is necessary and significant to do so, traverse runs can be made in several directions across the illuminated plane and complete data can be obtained on the radiation coverage produced by a given lamp.

The Scanner Instrument

The lamp scanner instrument[4] designed for this survey procedure, developed and built at the College of Medicine, is shown in figure 2. This apparatus is essentially a recording infra-red intensity meter which makes a linear response record of infra-red intensities observed by the radiation receiver (a sensitive bolometer element) of the scanner.

The radiation receiver is mounted in the scanner head (shown in position on the traverse bar). The scanner head is made to move uniformly in a traverse direction by synchronous motor drive, linked electrically with the synchronous drive of the chart paper shown in the recording milliammeter mounted on the laboratory wall. As the scanner head moves in traverse,

4. Rovner, Leopold, and Tyson, O. A.: A Radiation Pattern Scanner, Rev. Scientific Instruments, to be published.

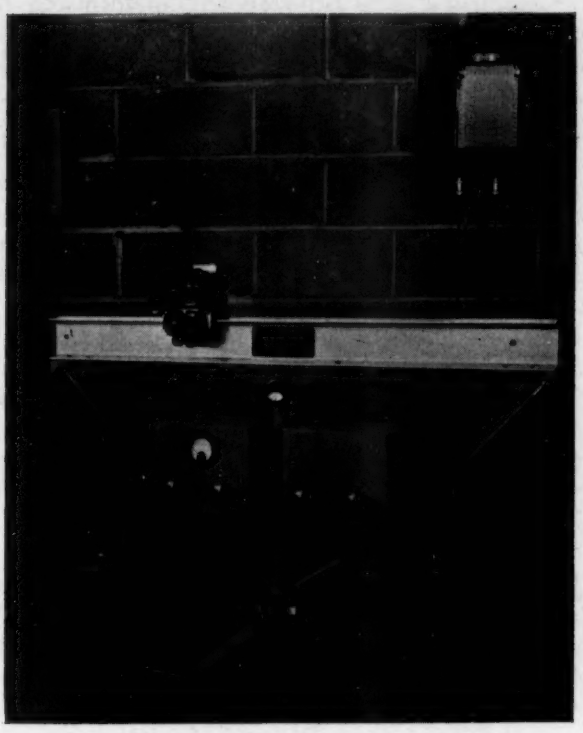
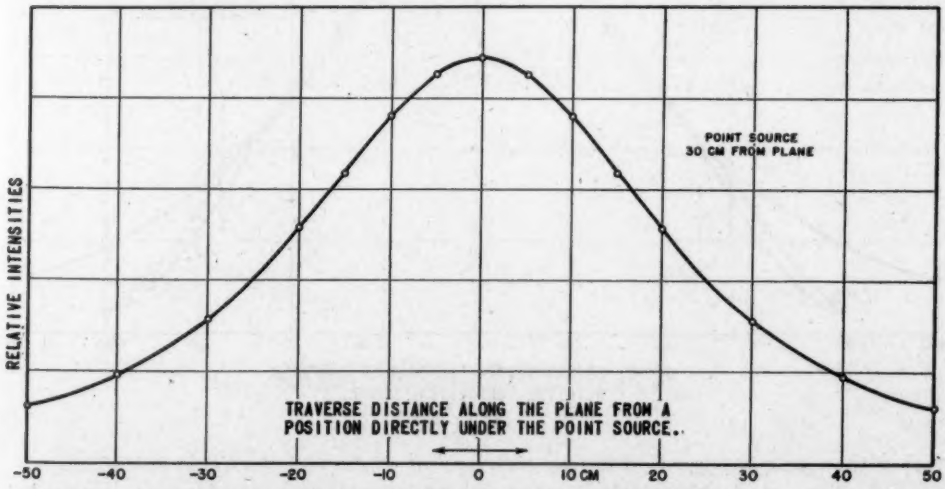


Fig. 2

chart paper is synchronously fed past the pen of the recording meter and a record is made of the infra-red intensities observed by the receiver element of the machine.

The electrical components of this device consist of the necessary electrical power supply and amplifier-and-recorder circuitry to make a linear response plot of infra-red intensities incident upon the bolometer receiver.



THEORETICAL COVERAGE PATTERN CURVE FOR THE ILLUMINATION OF A PLANE BY A POINT SOURCE.

Fig. 3

The receiver element has a flat response to infra-red radiation af all wavelengths between 0.8 and 15.0 microns. The bolometer strips have a very short thermal time constant (of the order of 8 milliseconds) so that modulation of the incident radiation at 30 cycles per second is readily accomplished with a rotating shutter mounted in the scanner head to allow use of a stable alternating current amplifier in the equipment.

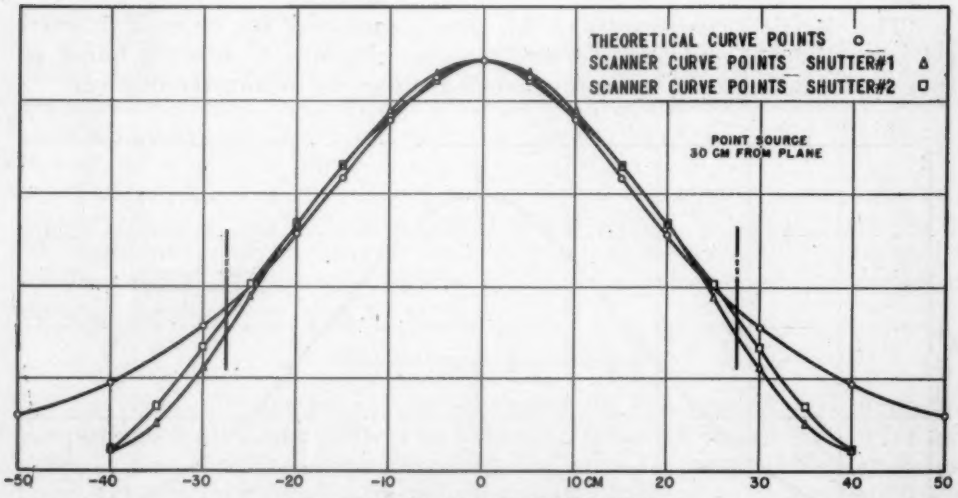
A single traverse run to give one complete coverage pattern over a distance of 100 cm. is made in 3 minutes. Since the machine is automatic and relatively fast responding, it is well adapted to rapid evaluation of coverage patterns that can be observed on a large series of lamps.

Figures 3 and 4 show the physical validity of this method of lamp survey, as determined from careful check measurements made on the response characteristics of the scanner instrument. These check measurements give the proper angular limits of quantitative operation of the machine.

Figure 3 is a curve showing the quantitatively ideal illumination intensity plot for a plane radiated by a point source of infra-red rays. (It should be noted that this curve is mathematically ideal, and is useful as such; it is not presented as the ideal of therapeutic illumination coverage by a practical therapy lamp).

Figure 4 shows, by measurement made on a lamp operating as a point source, how closely the scanner duplicates the theoretical illumination intensity curve and within what angular limits the machine should be used for faithful reproduction of the intensities of radiation from all points of a complex lamp structure.

The angular aperture of true observation of this instrument is 85 degrees. When all its radiating points lie within the true observation cone of the scanner, a complex, radiating lamp-structure has its radiations observed quantitatively and properly by the instrument.



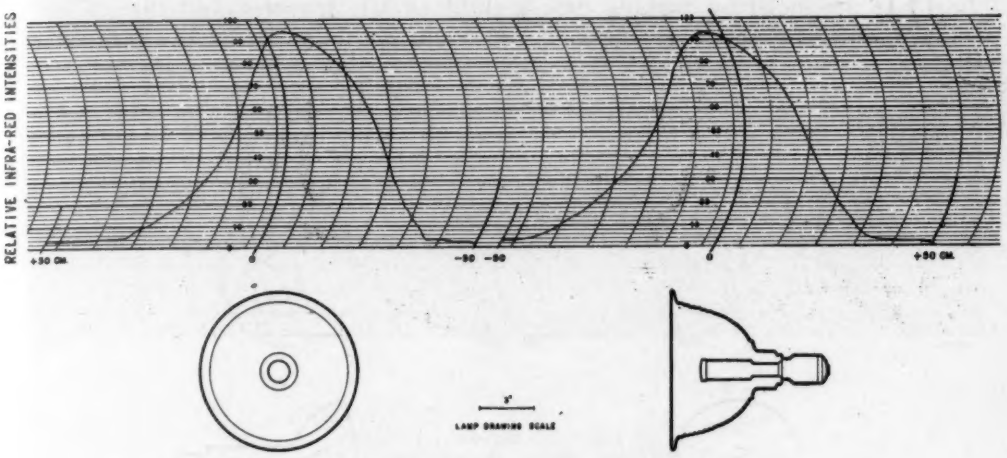
CURVES OBSERVED WITH THE SCANNER COMPARED WITH THE THEORETICAL CURVE.

Fig. 4

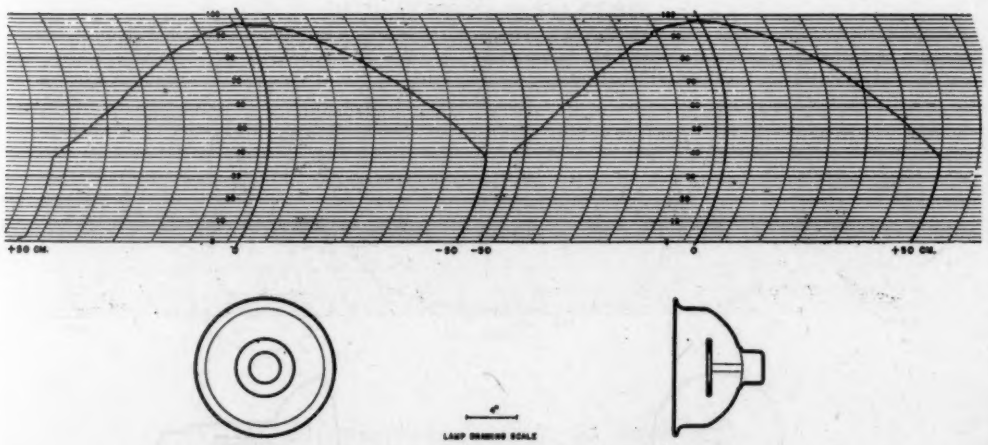
The recorded observations presented in the following data are made by the scanner under conditions of quantitative measurement defined within the limits of the curves of figures 3 and 4.

Coverage Patterns Observed

The curves of figures 5 *A* through 9 *B*, show in each case, two traverse runs made on the single lamp type illustrated in an accompanying drawing. Two traverse runs are presented for each lamp to show that the recorded coverage patterns are duplicated, and (within a ± 2 per cent fluctuation in the recorded data) are specifically characteristic of the particular lamp source being studied.



COVERAGE PATTERN FROM 300 WATT DULL GLOWING CARBORUNDUM SOURCE IN REFLECTOR MOUNT
Fig. 5A

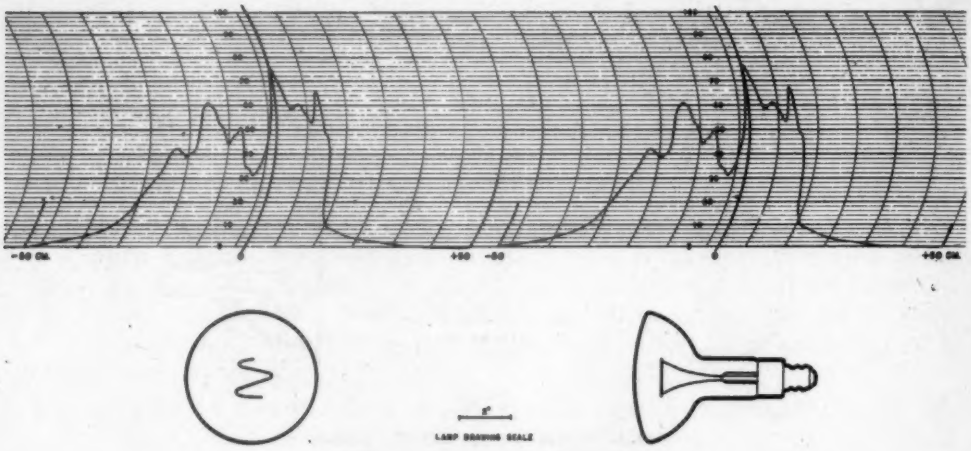


COVERAGE PATTERN FROM 600 WATT DULL GLOWING RING SOURCE, IN REFLECTOR MOUNT TWO TRAVERSE RUNS
Fig. 5B

The patterns were adjusted, in the case of each lamp, to give nearly full scale deflection for the highest intensity part of the coverage pattern. This was done by setting the amplifier gain on the scanner to a suitable fixed value desirable for a good record on the particular lamp being examined.

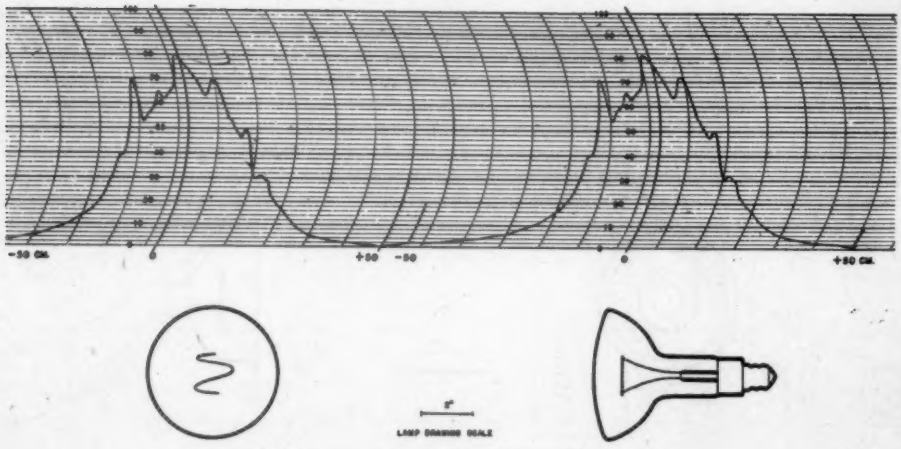
These coverage patterns show true relative amplitudes of infra-red intensities for the coverage of a single lamp. The separate patterns should be intercompared only for the relative coverage properties of the lamps indicated and should not at this time be compared for the relative over-all intensities of the lamps.

Figure 5 *A* shows the coverage produced by a small 300 watt dull-glowing carborundum source in a diffuse-finish aluminum reflector mount. The slight mirror image asymmetry of the peaks relative to the central zero line was produced by making first a right to left traverse and then a left to right one, the paper feeding as to the right continuously in the recording shown.



COVERAGE PATTERN FROM DARK FILTER 250 WATT
TUNGSTEN BULB #1 INTERNAL REFLECTOR

Fig. 6A

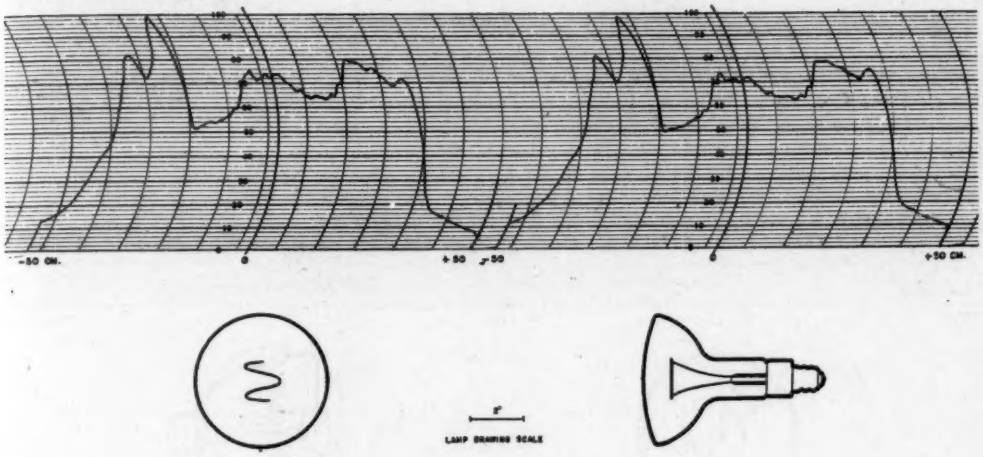


COVERAGE PATTERN FROM DARK FILTER 250 WATT
TUNGSTEN BULB #1 ROTATED TRAVERSE ASPECT.

Fig. 6B

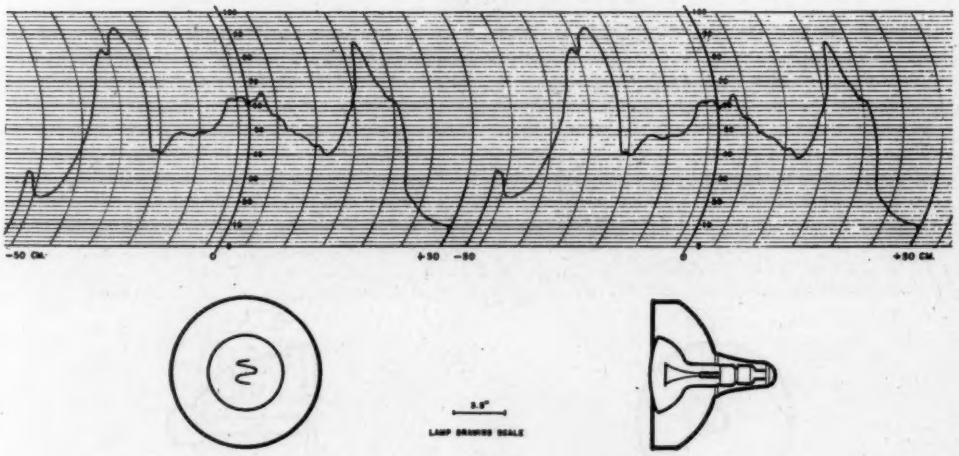
The pattern of figure 5 *B* is produced by a 600 watt dull-glowing ring source mounted in a reflector mount having an aluminum paint reflecting surface.

The sharp drop in the intensity record plot at each end of the traverse is due to the cut-off of the scanner circuits at these limits and is not due to the lamp pattern, which may be considered to extend outward in a smooth distribution curve.



COVERAGE PATTERN FROM DARK FILTER 250 WATT TUNGSTEN BULB #3 INTERNAL REFLECTOR.

Fig. 7A

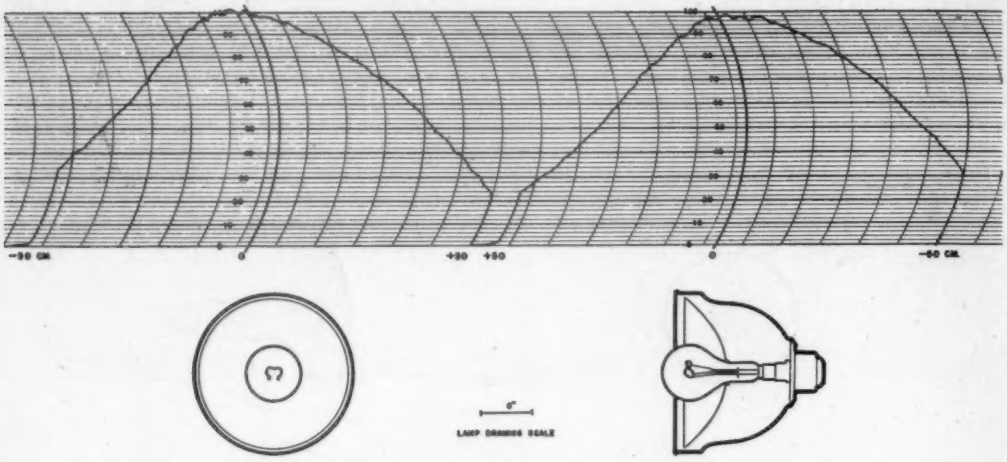


COVERAGE PATTERN FROM DARK FILTER 250 WATT TUNGSTEN BULB # 3 (INTERNAL REFLECTOR) MOUNTED IN EXTERNAL METAL REFLECTOR

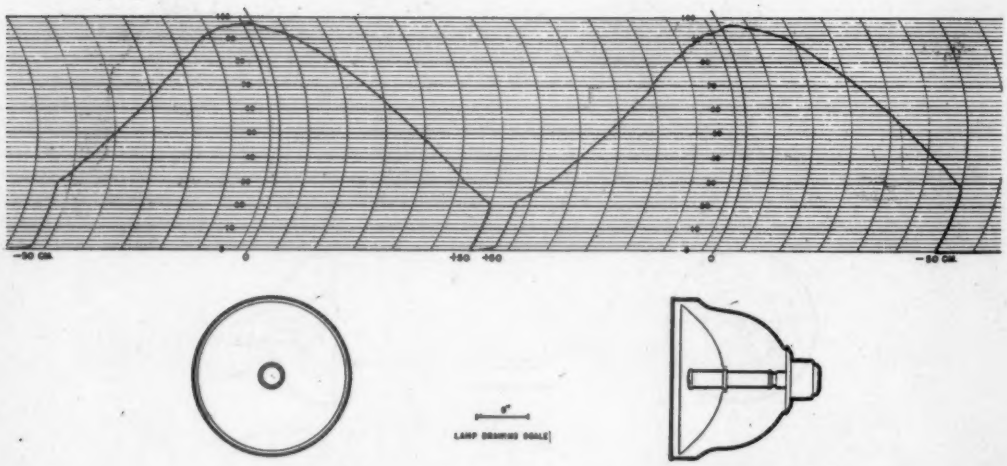
Fig. 7B

Figures 6*A* through 7*B* are coverage patterns of 250 watt lamps having mirror-bright internal reflectors, and the particular Σ-shaped tungsten filament shown, mounted within a dark glass envelope having good transmission properties for infra-red radiation between about 1.0 and 4.0 microns. The irregular patterns observed in all cases, here, are due to the image-forming properties of the bright internal reflector which projects an enlarged and irregular image of the filament on the plane of the traverse survey. It should be noted, since these lamps have an irregular focussing action when

clear glass is used for the lamp envelope, that any patterns observed would vary in a largely incoherent fashion with varying distance from the lamp source. The patterns shown are definitive for the particular traverse and the particular distance at which the lamps of figures 6 *A* through 7 *B* were observed.



COVERAGE PATTERN FROM 1000 WATT BRIGHT TUNGSTEN SOURCE
CLEAR GLASS IN REFLECTOR MOUNT
Fig. 8A



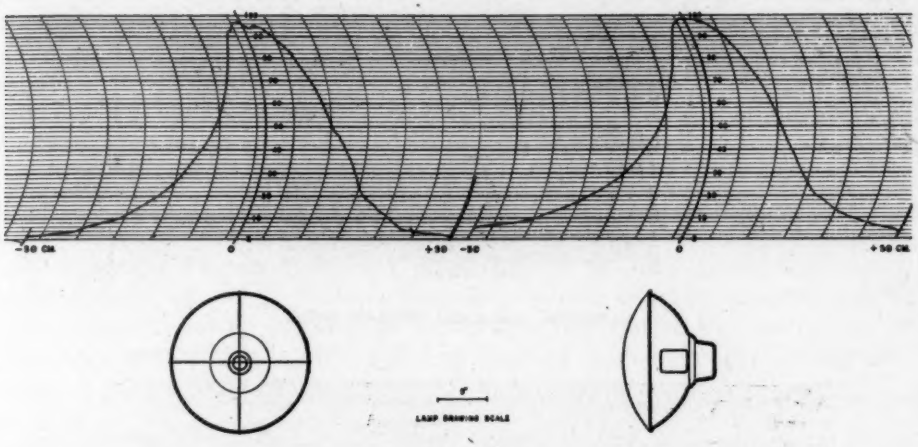
COVERAGE PATTERN FROM 1000 WATT GLOWING
CARBORUNDUM SOURCE IN REFLECTOR MOUNT
Fig. 8B

The lamp of figure 7 *B* was studied mounted in an external bright polished copper surface reflector, and, as might be expected, the external reflector had very little effect on the pattern, most of which was produced from the tungsten filament by the bright internal reflector of the lamp bulb.

Figure 8 *A* is a study of a 1,000 watt bright tungsten filament source mounted in a reflector having a diffuse aluminized reflecting surface.

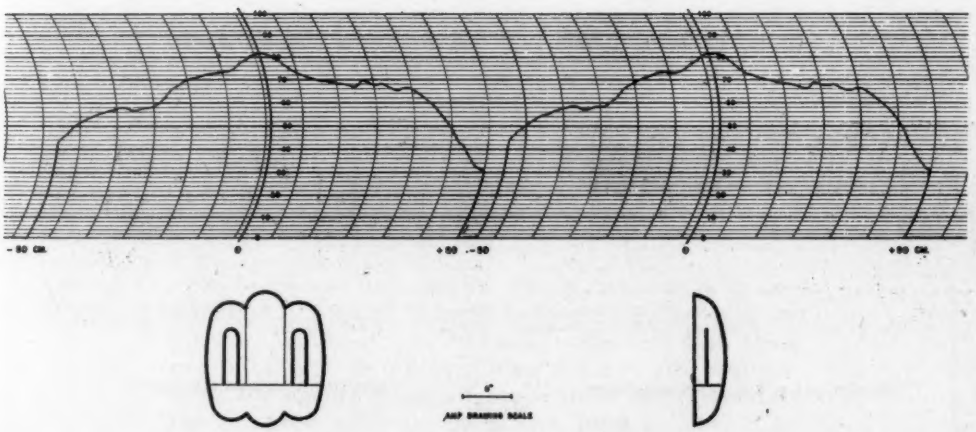
The curves of figure 8 *B* were produced by a 1,000 watt dull-glowing carborundum source mounted in the same type of reflector as that of figure 8 *A*.

An interesting (and useful) narrow beam emitter is shown in figure 9 *A*, and a very broad-coverage pattern (3.5 feet in width) is shown produced by the lamp of figure 9 *B*.



COVERAGE PATTERN FROM 500 WATT DULL GLOWING CERAMIC SOURCE IN POLISHED REFLECTOR MOUNT

Fig. 9A



COVERAGE PATTERN FROM DUAL 500 WATT DULL GLOWING CURVED ROD SOURCES IN REFLECTOR MOUNT

Fig. 9B

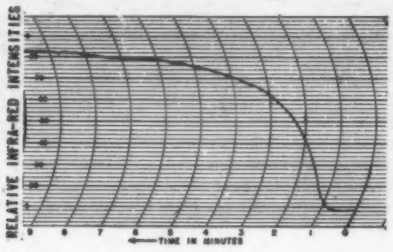
Start-Up Characteristics

By keeping the carriage of the scanner head stationary in the center of a coverage area while a record of intensities was being run, it was possible to get a plot of intensity against time for infra-red radiation from various sources.

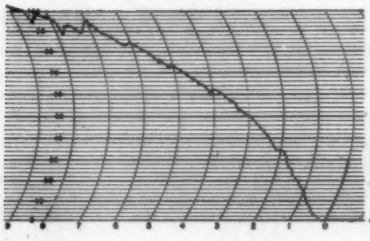
It was especially interesting to observe the infra-red start-up characteristics of lamps with large-sized sources having a relatively high thermal

inertia (lamps of this kind coast through momentary current interruptions with little change in output intensity).

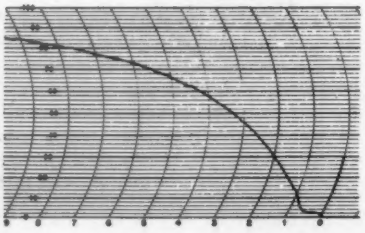
From the curves of figure 10 it will be seen that lamps of the dull-glowing sort which have a relatively massive source structure (other than a freely mounted dull-glowing wire, say) require of the order of ten minutes of time to come up to a sensibly stable radiation output level.



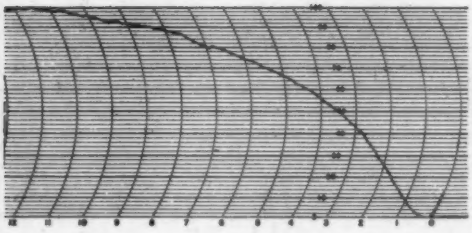
500 WATT DULL GLOWING DUAL CURVED ROD SOURCES



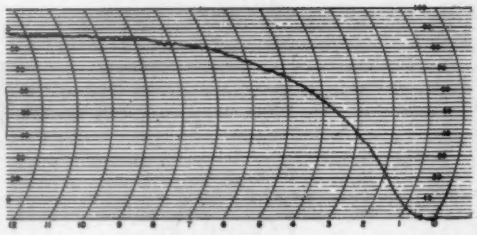
500 WATT DULL GLOWING CERAMIC SOURCE



300 WATT DULL GLOWING CARBORUNDUM SOURCE



1000 WATT DULL GLOWING CARBORUNDUM SOURCE



600 WATT DULL GLOWING RING SOURCE

Fig. 10

Conclusions

From the coverage studies made thus far it would seem that a selection of lamps should be made for particular therapeutic uses.

For whole body coverage a lamp with a very broad coverage pattern is indicated, and for a spot area one may either limit the rays from a broad coverage unit with proper diaphragms placed on the treatment surface or use a narrow beam infra-red source lamp, such as the one of figure 9 *A* or of figure 5 *A*. Dual purpose coverage may be obtained from lamps of the type shown in figures 5 *B* and 8 *A* and 8 *B*.

It should be observed that diffusing reflectors can be used to produce smooth, broad coverage patterns when used with either small line type (filament) or large type (ceramic) sources. Reflectors of the diffusing type are

least vulnerable to pattern distortion if the reflector surfaces should become dented through accidental damage.

For controlled, narrow beam coverage a large surface area source, such as the ceramic type, mounted in a bright reflector, makes a successful combination.

Since a mirror-bright curved-reflector shape and a narrow line structure source such as a brightly glowing tungsten filament produce sharp image formation, lamps of this type should be used when there is adequate optical control of the filament shape and its positioning and properly accurate optical structure of the curved, mirror-bright reflecting surface; as suggested by Howard Haynes,[5] the front of this kind of bulb could be a diffusing one.

Dr. Curtiss J. Humphreys, Chief of the Radiometry Section, United States Bureau of Standards, has arranged to calibrate some large 2 kilowatt bright tungsten filament radiation standards for the use of this laboratory. As these standard lamps become available, further coverage studies will be made giving intensity outputs in milliwatts per square centimeter, or in pyrons, the unit which is often used in English infra-red radiation studies.[3]

5. Haynes, Howard: Personal communication from Nela Park Laboratory of the General Electric Company.

The cordial cooperation of Prof. J. T. McClintock in making available the extensive facilities of the Physiology-Pharmacology Shop is gratefully acknowledged, as are the careful work of Mr. Gerald Walters, responsible for production of the detailed mechanical structure of the scanner, and Mr. David Deeton, responsible for the successful assembly and operation of the electronic components of the apparatus.

VERTEBRAL CHANGES FOLLOWING EXPERIMENTALLY PRODUCED MUSCLE IMBALANCE *

Preliminary Report

MERYL MILES, M.S.
ST. LOUIS

In order better to understand alteration in alinement of the Vertebral column in humans, investigators have tried to produce, for study, a comparable condition in laboratory animals. The objective has been to create an imbalance between right and left sides of the vertebral column or between structures influencing it and by this imbalance to change its alinement. Procedures, carried out on one side of the body, which have changed the symmetry of the vertebral column in experimental animals are: retarding of growth of vertebral bodies,[1] removal of portions of ribs,[2] removal of muscles,[3]

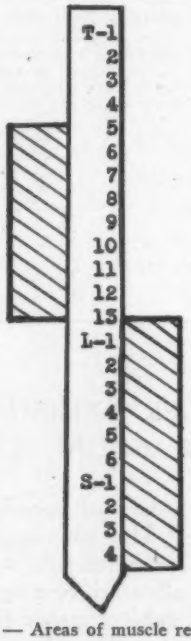


Fig. 1. — Areas of muscle removal

producing pleural adhesions,[2] and sectioning of nerves.[2-4] Maintaining the column in a position of abnormal alinement for a long period is another method of producing vertebral changes.[5]

* From the Department of Anatomy, Washington University School of Medicine, St. Louis.
* Aided by a grant from the Baruch Committee on Physical Medicine.
* Robert D. Heath, a member of the staff of Shriners' Hospital for Crippled Children, collaborated in these experiments until he entered the service of the United Stats Navy in April, 1946.
* Read at the Twenty-Fourth Annual Session, American Congress of Physical Medicine, New York, Sept. 6, 1946.

1. Bisgard, J. D., and Musselman, M. M.: Scoliosis. Its Experimental Production and Growth Correction; Growth and Fusion of Vertebral Bodies, Surg. Gynec. Obstet. 70:1029, 1940. Haas, S. L.: Experimental Production of Scoliosis, J. Bone & Joint Surg. 21:963, 1939. Engel, D., and Richer, A.: Experiments on the Production of Spinal Deformities by Radium. Part I. Am. J. Roentgenol. 42:217, 1939. Pacher, W.: Operative Erzeugüng einer Skoliose im Tierversuch. Ztechr. f. Orthop. 69:140, 1939.
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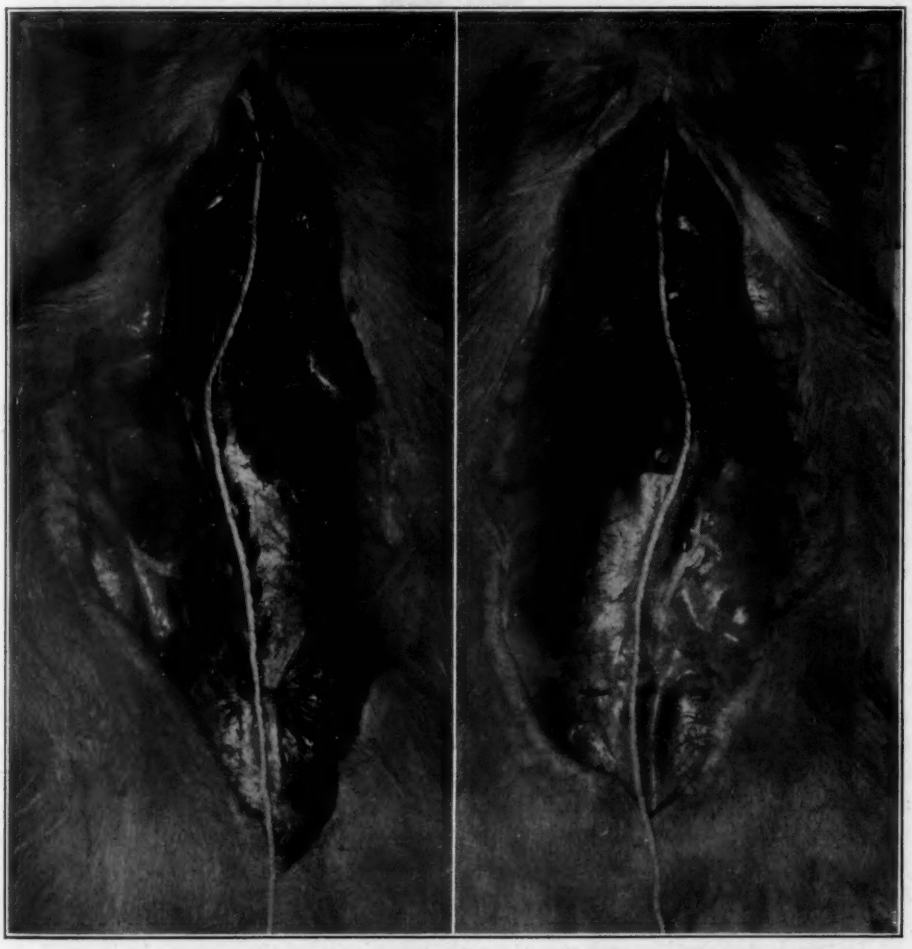
3. Arnd, C.: Experimentalle Beiträge zur Lehre der Skoliose. Der Ein fluss des Musculus grector trunci auf die Wirbelsäule des Kaninchens. Arch. f. Orthop. 1:145, 1903. Schwartzmann, J. R., and Miles, M.: Experimental Production of Scoliosis in Rats and Mice, J. Bone & Joint Surg. 27:59, 1945.
4. von Lesser, L.: Experimentelles und Klinisches über Skoliose, Virchow's Arch. Bd. 113, pp. 10-46, Berlin, 1888.
5. Müller, W.: Skoliosen im Tierversuch. Beiträge zur Klinischen Chirurgie 142:343, 1928. Wullstein, L.: Die Skoliose in ihrer Behandlung und Entstehung nach klinischen und experimentellen Studien. III. Experimentelle Erzeugung von Kyphoskoliosen und Kyphosen bei Hunden, Ztschr. f. Orthop. Chir 10:348, 1902.

In the first of the present experiments, imbalance between the two sides of the vertebral column was produced in 12 rats by muscle excision. The rats were approximately three and one-half months old at the time of operation. Back musculature was completely removed along one side in the thoracic region (from the fifth to the thirteenth rib) and along the opposite side in the lumbar and sacral regions (fig. 1). After a period of nine to fourteen months the animals were killed. The conditions observed may be classified under three headings: (1) alinement of the column as observed from the posterior view immediately after death and with the skin reflected;



C — Left C — Right

Fig. 2. — Alinement of vertebral column fourteen months after asymmetric removal of muscles. *C-Left*, right thoracic and left lumbosacral muscles removed; *C-Right*, left thoracic and right lumbosacral muscles removed. The cotton string marks the tips of the spinous processes. Pins are located at the second and thirteenth thoracic vertebrae and the lumbosacral junction.

(2) alinement of the column as observed from the anterior view after it was cleared of tissue down to the articulations; (3) changes in individual vertebrae after skeletonization.

Alinement of the column from the posterior view was recorded by a tracing glass or by a photograph (fig. 2). The most pronounced part of the resultant curve was in the thoracolumbar region with concavity on the side of intact lumbar muscles: that is, in the one with concavity on the right muscles were intact in the lumbar region on the right; in one with concavity on the left muscles were intact in the lumbar region on the left. The apex

Fig. 3. — Anterior view of vertebral column and pelvis as prepared for examination for lateral curvature and rotation.

of this lateral curve was also the apex of a curve in the sagittal plane which appeared as a posterior convexity of the column in the thoracolumbar region.

Ten columns were prepared for examination from the anterior view (fig. 3). In the examination for lateral curvature and in the examination for changes in individual vertebrae, the vertebrae above the fourth thoracic were not considered. Of these, four showed no curves or such slight ones as to be questionable. Three showed C-shaped and three showed S-shaped curves with their concavities (in four of six) on the side of intact muscle. With the pelvis fixed in the anatomic position, each column was also examined for rotation. The vertebrae which appeared to be rotated were those from the fourth thoracic through the first lumbar with a transition in direction of rotation within this segment. This transition from rotation in one direction to rotation in the opposite direction occurred at the ninth and/or the tenth thoracic. Rotation was observed in all columns and followed a fairly constant pattern. The vertebrae above the transitional one (or ones) --that is, above the ninth and/or tenth thoracic—rotated toward the side of intact thoracic musculature and those below rotated toward the side of intact lumbar musculature.

In the individual vertebrae after skeletonization the most obvious change was the deviation of the spinous process. This deviation is a result of a change in the lamina and was present in the ninth thoracic and succeeding vertebrae through the second sacral. Its direction was toward the side of intact muscle. There were also present asymmetries of articular processes, transverse processes and vertebral foramens. The change in the vertebral foramen seems to be the result of shortening of the lamina of one side.

In summary, on this series of rats it may be said that removal of back muscles from one side in the thoracic region and from the opposite side in the lumbosacral region was followed by (1) deviation of the spinous processes associated with asymmetry of the lamina, which gives the column from the posterior view the appearance of lateral curvature in the thoracolumbar region; (2) increased posterior convexity in the thoracolumbar re-

gion; (3) lateral curvature, observed from the anterior view, which showed variation in both direction and location; (4) rotation of lower thoracic and upper lumbar vertebrae.

In progress now is an experiment which includes an attempt at production of an imbalance between the two sides by a less drastic means than

Fig. 4. — Area of muscle removal, nerve removal or nerve exposure.

muscle excision—that is, by the removal of posterior primary divisions of spinal nerves (approximately 3 cm. of each nerve). Three procedures are under way. They are (1) removal of muscle, (2) removal of portions of posterior primary divisions of spinal nerves, (3) exposure of posterior primary divisions of spinal nerves without removal.

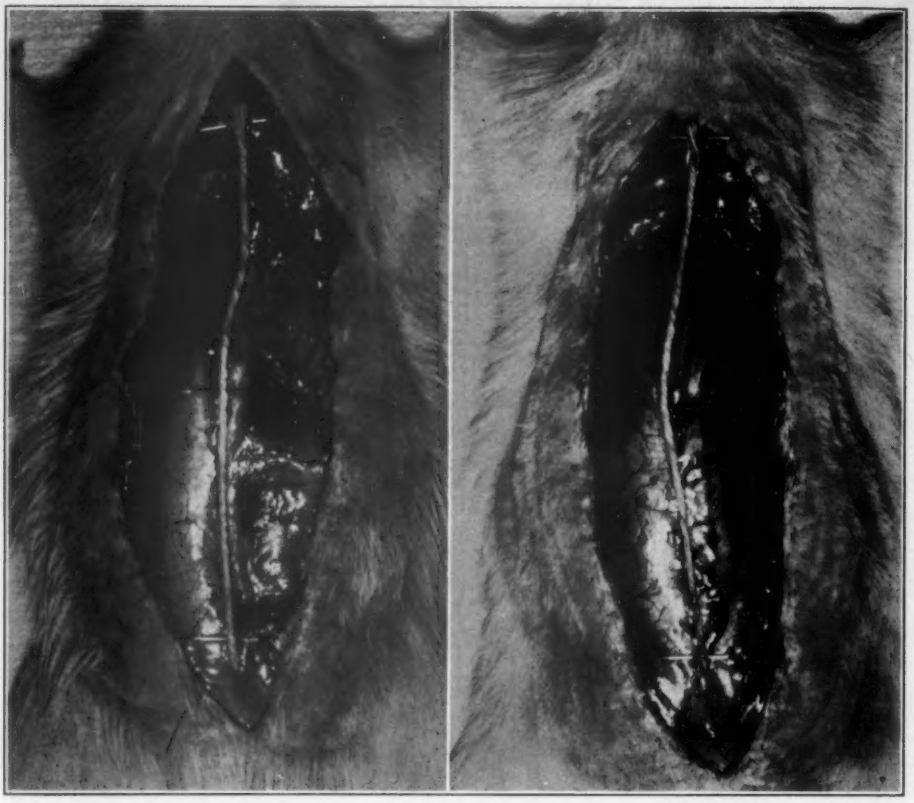
The animals used are 80 male rats whose ages ranged at the time of operation from 6 weeks to 2 months. Each procedure was limited to one side of the back. It is the purpose in the first two procedures to have a comparison of the effect of muscle removal with the effect of muscle denervation. The third procedure, that of nerve exposure, is undertaken as a control in order to separate the effect of muscle damage as the nerves are made available for removal from the effect of actual removal.

The area of muscle removal, nerve removal or nerve exposure was limited in each case by the seventh rib and the crest of the ilium (fig. 4). In the case of muscle removal, the area was also limited by the spinous processes and the lateral border of the sacrospinalis group.

Seven months after operation the 76 surviving rats were examined under anesthesia for vertebral column deviation. After reflection of the skin a cotton string was placed along the tips of the spinous processes, and pins were inserted to mark the levels of the second and thirteenth thoracic vertebrae and of the lumbosacral junction. A record of the alinement of each column from the posterior view was made by a photograph.

Most of the columns as judged from the photographs, were classified as showing one of two types of curvature: either an S-shaped curve in which the inferior portion of the S extended over a greater distance than the superior portion or a C-shaped curve (fig. 5).

The accompanying table summarizes the alinement of the vertebral columns seven months after operation. With 2 exceptions, the muscle removal



S — *Left* C — *Left*

Fig. 5 — Alinement of vertebral column seven months after unilateral removal of muscles (*S-Left*) and nerves (*C-Left*). The cotton string marks the tips of spinous processes. Pins are located at the second and thirteenth thoracic vertebrae and the lumbosacral junction.

*Alinement of Vertebral Column Seven Months After Operation.**

Operative Procedure	Number of Animals	No Change	S-Curve, Right †	S-Curve, Left	C-Curve, Right ‡	C-Curve, Left	Miscellaneous
Muscles removed, right	14	1	12	....	1	....	
Muscles removed, left	12	....	....	12	....	....	
Nerves removed, right	14	1	2	....	10	....	1 concave in T-region, right
Nerves removed, left	13	1	....	6	....	4	2 concave in L-region, left
Nerves exposed, right	11	3	1	....	6	....	1 concave in L-region, right
Nerves exposed, left	12	5	....	1	....	5	1 concave in L-region, left
Totals	76	11	15	19	17	9	5

* As determined by posterior view photograph.

† An S-shaped curve in which the inferior portion of the S extends over a greater distance than the superior portion. The classification *S-curve, right,* includes those curves with inferior convexity facing the right side.

‡ A C-shaped curve or "total curve" — one in which the deviation is to one side only. The classification *C-curve, right,* includes those curves with convexity facing the right side.

procedure, carried out in 26 animals, was followed by vertebral changes that gave an S-shaped appearance to the alinement of the supinous processes. When nerves were removed on the right side, 10 of the 14 columns were concave on the right. The remaining procedures brought less constant

results. Although nerve removal and nerve exposure were carried out on equal numbers of rats on the right and left sides, the C-shaped curves appear nearly twice as often with concavity on the right as on the left. In the control group the majority also showed changes in alinement.

From the observations made seven months after operative procedures carried out on 80 young male rats, it appears that an imbalance followed by alinement changes, as observed from posterior view photographs, may be produced by muscle removal or nerve removal along one side of the vertebral column. In general, when muscles are removed the alinement of the spinous processes presents an S-shaped appearance. After nerve removal, the commonest alinement pattern is that of a C-shaped curve. The concavity in the case of nerve removal, and the major concavity in the case of muscle removal, faces the side operated on. Whether these effects and the differences between effects in the two procedures are in the spinous processes only or whether the vertebral bodies are involved will be determined after the columns are skeletonized. Since change in alinement has occurred also in the control animals, the effect on the vertebral columns of the rats subjected to nerve removal may not be attributable entirely to decreased innervation.

It is hoped that the degree and direction of deviation can be correlated with a specific measure of imbalance. The experiment is still in progress.

A POLIOMYELITIS PROGRAM IN A GENERAL HOSPITAL *

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A general hospital is the best place in which to care for persons with acute poliomyelitis and those in early convalescence from the disease because only there is it possible to offer all the general and specialized medical and nursing service and the facilities necessary for the optimum care of the patient with this disease. Without hospitalization, the entire management plan of this disease collapses. A hospital built solely for the purpose of caring for the early phase of poliomyelitis would be thoroughly impractical and uneconomical, since this is a seasonal disease and would thus leave expensive facilities idle much of the time.

A community or city should be able to rely upon its hospital facilities for care in all health matters, but, in so doing, the community itself must be prepared to help when the need arises. This need arises in no greater proportions than when a sizable epidemic of poliomyelitis strikes. The three basic requirements for all hospital care are bed space, equipment and trained personnel. Today the supply of all three is strained almost to the breaking point, but with foresight and planning on the part of the hospital and the community minimal essentials can be provided. The National Foundation

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for Infantile Paralysis, through its local and county chapters, has provided very real assistance in organizing community help and in supplying to the hospital trained lay and professional personnel and equipment. Seasonal bed space, then, is probably the most universally difficult of the basic requirements to provide.

Over and beyond these basic requirements comes the important factor of interdepartmental medical relationships. Poliomyelitis differs markedly from diseases in that when the acute phase is completed treatment is no less complicated and continues to be a problem for months, and perhaps even years. Good management of the patient requires a well integrated team of physicians and technical assistants, consisting of a pediatrician, a physiatrist, an orthopedist, a nurse, a "packer," a physical therapist, and, on occasion, a psychiatrist, an occupational therapist and a vocational guidance and training expert. These, then, form the group of specially trained workers necessary, in part or in whole, for the ultimately full rehabilitation of a poliomyelitis patient. Needless to say, all members of this team must work in close cooperation to achieve anything approaching optimum results. In order to achieve smooth functioning of such a diversified unit of specialists, at least one must have the initiative and the authority to pull the whole together. This might fall within the province either of the pediatrician or of the orthopedist or of the physiatrist, depending upon local conditions and the stage in treatment. Since the prevention of deformities, the reeducation of residual motor units and the use of aids to improve body mechanics lies largely in the field of physical medicine, the physiatrist, when available, is probably the most logical member of the team to assume responsibility for the overall organization of this care, especially in its convalescent stage. The pediatrician should exercise controlling management of the patient during the acute phase of the illness, with the orthopedist superceding the physiatrist during the chronic stage, when reconstructive surgical procedure may be indicated. Continuity of interest by all during the successive phases of the disease is inseparable from good treatment.

Between July, 1945 and November, 1945, there were 191 patients admitted to the Medical College of Virginia Hospitals with a diagnosis of acute anterior poliomyelitis. Of these, 82 per cent were white and 18 per cent were Negroes. One hundred and forty-nine, or 77 per cent, were discharged home with no or minimal disabilities, amenable to outpatient check-ups and home treatment programs. These were followed in the Medical College of Virginia orthopedic clinics and the Baruch Center of Physical Medicine. Thirteen patients, representing about 7 per cent of those admitted, were referred to a crippled children's hospital, whereas 20, or about 10 per cent, were discharged to the care of private physicians or other clinics. Three adult patients were sent to an orthopedic hospital in another state, and 1 Negro patient was sent to Tuskegee Hospital for Infantile Paralysis. In July, 1946, 1 patient, the onset of whose disease occurred in the 1945 epidemic season, remained hospitalized at the Medical College of Virginia Hospital.

The average length of stay in the hospital was forty-five days for white patients and seventy-nine days for Negro patients. This discrepancy in time spent in the hospital was probably due to the fact that there are less adequate facilities for the convalescent care of Negro children in this area than those available to white children, either in the home or in other hospitals and clinics.

Of the 149 patients who were discharged home, only 5 failed to return for check-up and further treatment. The Crippled Children's Bureau of the Virginia State Health Department investigated these patients and made it possible for them to report to other clinics nearer to them for follow-up care.

The year 1945 was the first in which the Medical College of Virginia Hospitals had a physical medicine department administered by a physician with specialized training in this branch of medical practice. This physiatrist assumed the responsibility for the organization of the day by day management of patients with acute and convalescent poliomyelitis. The following plan of physical treatment, clarifying responsibility and control, was set up and placed before the chiefs of the pediatric and orthopedic service for discussion and approval:

1. Bedboards and footboards shall be provided for all patients.
2. Unnecessary handling of the patient shall be avoided. Acutely ill patients shall be fed.
3. Initial muscle analysis shall be made by the physical therapist and/or the physiatrist, for the purpose of:
   a. Detecting areas of hyperirritability and spasm.
   b. Arriving at a preliminary estimate of the extent and distribution of the major muscle weakness.
4. Muscle analysis shall be repeated at the end of the first, second and third week of illness.
5. Muscle analysis shall be recorded on a special chart. Careful note shall be made of all significant changes in muscle status. A minimum of four analyses shall be made on all patients as specified in "4."
6. Muscle groups to be packed shall be recommended by the physical therapist responsible for the treatment of the patient, subject to the approval of the physiatrist.
7. Hot packing and special nursing care shall be under the supervision of a nurse physical therapist with postgraduate training in the care of patients with poliomyelitis.
8. When indicated, intermittent hot packs shall be given every two hours, five times daily, the packs to be removed at the end of one hour. Patients receiving packs shall be given salt replacement.
9. Localized severe and painful spasm shall be subjected to concentrated packing (every fifteen minutes for one hour) twice daily.
10. Spasm of respiratory muscles affecting pulmonary ventilation shall have concentrated packing (every fifteen minutes for one hour) twice daily.
11. A rolled towel shall be placed under the knees of acutely ill patients, as specified by the physical therapist, and sandbags shall be used as indicated.
12. There shall be careful control of body alinement after each application of packs, as specified by the physical therapist in charge.
13. When pain, tenderness and spasm have largely subsided, fomentations shall be discontinued on the recommendation of the physical therapist, subject to the approval of the physiatrist.
14. If muscle shortening and pain persist after prolonged and efficient use of hot packs, other forms of thermotherapy shall be tried, such as the Hubbard Tank, luminous infra-red radiation and the paraffin bath.
15. The physiatrist, in consultation with the pediatrician, shall determine when bedside treatment may be replaced by treatment in the physical therapy department. Since good muscle training requires the undivided attention of both the patient and the physical therapist, it is suggested that as soon as possible after the patient is out of isolation, treatment be carried out in the physical therapy department.

16. When spasm and pain have subsided, the first manual muscle test can be performed. The physiatrist shall determine when the patient is ready for muscle testing.
17. All manual muscle tests shall be given by a physical therapist, the same physical therapist performing repeated tests on the same subject.
18. A modification of the form used at the Georgia Warm Springs Foundation shall be used for recording the results of manual muscle testing.
19. All patients shall receive a manual muscle test before discharge.
20. Before discharge, record shall be made also of the patient's ability to stand, walk and perform stair climbing. Abnormalities in gait shall be described.
21. Muscle tests shall be performed monthly on all patients returning to the physical therapy department for outpatient care.
22. Manual muscle tests shall not be performed on children under 2 years of age, since such tests are unreliable when performed on the very young.
23. The exercise program shall begin at the earliest moment. It will progress systematically through the following stages, the rate of progression being determined by the physical therapist, subject to the approval of the physiatrist:

    a. Tendon stimulation and passive motion through the pain-free arc shall be done at least once daily in the acute phase. This shall be done only by the physical therapist.
    b. Rhythmic, reciprocal, active-assisted motion with meticulous individualization of prime movers shall commence when spasm and pain have diminished sufficiently to permit relaxation.
    c. This type of reeducation exercise shall be given to every muscle in the affected area.
    d. When passive motion is painless and when no intrinsic or extrinsic incoordination accompanies active-assisted movements, active exercise through the full voluntary arc shall commence.
    e. Persistent tightness shall be subjected to early forced stretching, preceded by thermotherapy.
    f. Plinth exercises may be supplemented by underwater exercise in the Hubbard tank or pool when pain subsides, incoordination disappears and voluntary exercise is permitted.
    g. Sitting shall not be permitted until the recommendation of the physical therapist and physiatrist is aproved by the orthopedic consultant.
    h. Weight-bearing shall not commence until recommended by the physiatrist and approved by the orthopedic consultant.
    i. Adequate balance training shall precede all attempts at locomotion.
    j. The need for aids to locomotion, support, etc., shall be determined by the orthopedic consultant in conference with the physiatrist and the physical therapist caring for the patient.
    k. On discharge, a home treatment exercise program shall be prescribed by the physiatrist and given to the patient in writing, after it has been taught to a responsible member of the family by the physical therapist.
    l. Discharged patients returning to orthopedic clinic for check-up shall also report to the physical therapy department for check-up and/or further treatment.
    m. The physical therapist shall attend the orthopedic clinic to integrate better the after-care program.

24. The following plan is proposed to expedite continual medical supervision of the treatment program, as well as the in-service training of the entire technical staff in the highly specialized procedures used in the reeducation of muscle function:
    a. The facilities of the physical therapy department shall be closed to all other patients during specific hours to be designated.
    b. Voluntary help shall be provided by the hospital administrator for the transporting of patients to the physical therapy department and their return to the wards.
    c. Express elevator service shall be available during these hours, if possible.
25. The physiatrist shall be consulted before orders for discharge are given.
26. It is recommended that the special forms used in keeping accurate records on all patients receiving physical therapy be made a part of the patient's hospital record, subject to the approval of the record committee.

With the somewhat recently acquired recognition of the importance of spasm and of its control in acute poliomyelitis came the immediate problem of its early relief. It has been the experience of workers in the field of poliomyelitis that when this spasm is relieved completely and early, the secondary deformities, not attributable to paralysis per se, which formerly so frequently resulted from this disease, are prevented to a large degree. In order to relieve this spasm, heat in some form is applied to the skin overlying the muscle groups involved. The most effective means so far, in the majority of cases, has been the use of moist heat in the form of hot packs. The adequate application of these packs requires a team of workers. Nurses, of course, can apply the packs, but, when thus utilized, highly trained skilled workers are being used for a technical procedure which can easily and quickly be taught intelligent lay workers. In addition, all professional workers must be given the training that the special skills in handling poliomyelitis require.

During the epidemic season of 1945, packs were applied in most instances by nurses. As time went on and the number of cases continued to increase, a few lay persons, chiefly parents or friends of some patients, volunteered their services and were trained by the physical therapy department to assist with the application of packs. This continual training of new personnel meant a great duplication of effort and made evident the urgent need for organized education of lay groups before another epidemic was encountered. Accordingly, the National Foundation for Infantile Paralysis, working through its state and local chapters, has this year inaugurated a program for the training of a reserve pool of workers under its Polio Emergency Volunteer Plan. The facilities of the hospital and the medical school, the services of local physicians, the help of community, public health and social service agencies have been added to the efforts of the National Foundation.

When poliomyelitis strikes in epidemic proportions, few hospitals have on their staffs sufficient numbers of physical therapists especially trained in the care of poliomyelitis to handle the increased patient load. The only agency thus far available for expediting the securing of qualified physical therapists is the National Foundation for Infantile Paralysis. Even the Foundation is hard pressed in epidemic times to find enough physical therapists to supply all needs quickly. It is difficult to see how this situation can be met by local personnel without recurrent seasonal jeopardy to other aspects of the institution's physical medicine program.

In a large general hospital, there is today the ever present element of

urgency in making available as many beds as possible. Emphasis tends to be placed on rapid turnover of bed occupancy, because of the ever increasing demands for more space for more patients. This feeling of haste in discharging patients is the arch enemy in the battle against poliomyelitis. If poliomyelitis is to be properly and adequately treated, one cannot hurry the process. In actual practice, many patients are discharged before the optimal time in the estimation of the physiatrist, upon whom depends the prescription of a long-term rehabilitation program.

Patients discharged from the hospital were referred to the outpatient clinics for continued orthopedic and physiatric care. Orthopedic problems which could not be corrected by physical therapy procedures were referred back to the orthopedic service, where the patients were seen at whatever intervals were deemed necessary. The prescription for the physiatric program was the responsibility of the physiatrist.

The disadvantages of not having a brace and corset shop located within the hospital were evident. This is a very important and often neglected part of poliomyelitis care. A patient may be carried through a long and costly program of treatment and rehabilitation, only to reach no good functional achievement because braces and corsets do not fit properly or are of inferior quality. This, too, requires specialized knowledge on the part of the physician and of the brace maker. Even more important, it requires closely cooperating teamwork and continuous attention to details.

Summary

Between July, 1945 and November, 1945, 191 patients were admitted to the Medical College of Virginia hospitals with a diagnosis of acute anterior poliomyelitis. This represented a sudden large influx of patients in need of specialized care. The Baruch Center of Physical Medicine and the Medical College of Virginia Hospitals provided this care in such full measure that the average time spent in the hospital was only forty-five days for the white patients and seventy-nine days for the Negro patients, and 90 per cent were discharged with no or minimal disabilities, amenable to outpatient check-ups and home treatment programs. Both the setting up and the carrying out of a program for the care of so large a group of poliomyelitis patients in a general hospital presented many problems. The major needs for this program were found to be:

1. Adequate bed space to be utilized as long as necessary for optimal treatment.
2. Adequate specialized nursing care.
3. Adequate subprofessional help for applying hot packs and for transporting patients from bedside to treatment center.
4. Adequate number of physical therapists especially trained in poliomyelitis care.
5. A closely cooperating team of physician-specialists in pediatrics, orthopedics and physiatrics.
6. A brace and corset shop, staffed by specialists, located within the hospital.
7. Adequate follow-up care and continued treatment as outpatients.

MUSCLE STRENGTH AND THE WEATHER*

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The works of Hippocrates, composed more than 2,000 years ago, contain many allusions to the influence of climate and weather upon body functions and upon the morbidity and mortality in various diseases. Through antiquity and the Middle Ages, climate and weather were considered as one of the most important etiologic factors. However, later, the advances in physiology, pathology and, finally, bacteriology and parisitology, especially those in the last century, provided the modern etiologic concepts such as, infection, trauma, heredity, organ exhaustion, organ inferiority on a constitutional basis, vitamin deficiency and in the frantic search for unitary etiologic factors for the various diseases, the analysis of the possible influence of the weather was neglected, if not completely rejected as an unscientific approach. The obvious influence of climate, at least upon the geographic distribution of some diseases, was explained either by increased exhaustion to which man is subjected in those climates or by the influence of climate upon the infectious agent or upon its vector or secondary host.

In the last twenty-five years, physicians of well established scientific renown, such as Helpach,[1a] Petersen,[1b] Mills[1c] and de Rudder,[1d] published books containing an enormous amount of data and careful analysis demonstrating the often distinct influence of climate and the generally more subtle influence of weather on body functions or reactions and, in this manner, on morbidity and mortality in diseases. Their success was due mainly to the fact that they discriminated much more distinctly than their predecessors between climate and weather, both affecting man through quite different mechanisms. Climate refers to average meteorologic conditions over long periods, whereas by weather is meant the hour to hour, or day to day, changes in prevailing atmospheric conditions, such as barometric pressure, temperature, humidity, precipitation, wind direction and velocity, cloudiness and sun radiation.

Since weather is of such a complex nature, it is difficult or impossible, despite the excellent meteorologic data available in most countries, to correlate in a simple and obvious manner weather as a whole with medical observations. Fortunately, there are certain aspects of the weather which have, as a rule, more distinct influences than others. Areas of high and low pressure moving across the country and bringing sharp, sudden changes in temperature to the region over which they pass, are apparently the weather components most effective upon body functions.[1] These meteorologic changes, often of cyclonic nature, are called "cold fronts" and "warm fronts." Passing of such fronts affects, for example, blood pH, leukocyte count and blood volume of a limb in normal subjects.[2] The individual susceptibility to weather changes varies greatly from subject to subject. In animal experi-

* From the Baruch Center of Physical Medicine, Medical College of Virginia.

* Read at the Twenty-Fourth Annual Session, American Congress of Physical Medicine, New York, Sept. 7, 1946.

1. (*a*) Hellpach, W.: Die geopsychischen Erscheinungen, ed. 3, Englemann, Leipzig, 1923. (*b*) Petersen, William, and Milliken, M. E.: The Patient and the Weather, Ann Arbor, Mich., Edwards Brothers, Inc., 1934-1938. (*c*) Mills, C. A.: Medical Climatology, Baltimore, Charles C. Thomas, Publisher, 1939. (*d*) De Rudder, B.: Grundriss einer Meteorobiologie des Menschen, ed. 2, Berlin, Julius Springer, 1939.

2. (*a*) Petersen, Wm. F.: Weather and Biochemical Variability, Arch. Biochem. 1:269, 1942. (*b*) Berg, M.; Mayne, A., and Petersen, W. F.: Variability of Blood pH and Its Association with Meteorological Factors, Am. J. Physiol. 130:9, 1940. (*c*) Petersen and Milliken. 1b

ments, change in drug toxicity was observed coinciding with sudden barometric and temperature changes.[3]

Since the weather changes detectably affect normal organisms, it is not astonishing that in diseases in which the patients are just able to maintain a precarious balance, weather changes often cause precipitation of symptoms or sharp exaggeration of already existing symptoms, and also distinct changes in the clinical course. This has been well demonstrated, for example, for glaucoma and certain other ocular disturbances,[4] tuberculosis,[5] asthma,[6] eclampsia, psychotic disturbances.[7] The influence of the weather upon the psyche finds its expression too in the correlation between frequency of suicides and passing fronts.[8]

For the physiatrist, the observations concerning poliomyelitis[9] are of special interest. For many patients, the period of prodromal symptomatology and/or the period of onset of paralysis coincides with the passing of a cold front during the warm summer months. Apparently passage of a cold front can have a similar symptom-precipitating influence on an organism infected with poliomyelitis virus as fatigue and chilling.[10]

All the present explanations for the influence of the passages of fronts upon the organism are vague and not very satisfactory. A shift in the balance of the autonomic nervous system towards sympathicotonia plays probably a major part.[1b] Whatever the final explanation will be, the fact that such weather changes often represent an excess burden for the organism is well established. Such an excess burden might also influence maximal muscle efforts of normal subjects and of patients. The only data which I could find in the literature were three doubtful or low correlation factors for dynamometer values and front passages, included in a large table of Petersen.[2a] According to a recent personal communication of Dr. Petersen, the calculations were based on three successive readings of a hand dynamometer, the test being performed by 3 subjects day by day. Dr. Petersen told me, too, in his letter that he performed a daily suspension test on the same 3 subjects. The subjects suspended themselves from a bar until they dropped. This test, which measures muscular fatigability, showed much higher correlation with the passage of fronts than the dynamometer values.

My own series of experiments cover a period from early fall, 1945 to summer, 1946. Several members of the Baruch Center participated, but owing to some changes in personnel and to various other circumstances, we did not succeed in getting day by day records for a large number of sub-

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3. Macht, D. J.: In discussion on Fenn, G. K., and Gilbert, N. C.: Anginal Pain as a Result of Digitalis Administration, J. A. M. A. 98:103, 1932. Nedzel, A. J.: Daily Variations in the Toxicity of Neoarsphenamine, J. Lab. & Clin. Med. 27:715, 1942.

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5. Howe, J. S.: Daily Variations in the Tuberculin Reaction, Am. Rev. Tuberc. 37:273, 1938. Schubarth, A., and Gruner, R.: Ueber Witterungseinflüsse auf Tuberkulosekranke, Ztschr. f. Tuberk. 83:12-22, 1939. Petersen, W. F.; Howe, J. S., and Millikan, M. E.: Weather and Resistance in Tuberculosis, Am. Rev. Tuberc. 44:377 and 548, 1941. Petersen, W. F.: The Clinical Episode in Tuberculosis and the Meteorological Environment, ibid. 46:407, 1942.

6. Petersen, W. F., and Vaughan, W. T.: Weather and Death in Asthma, J. Allergy 15:97, 1944. Petersen and Milliken. 1b

7. Bach, E., and Shluck, L.: Untersuchungen über den Einfluss von meteorologischen, inosphärischen und solaren Faktoren sowie der Mondphasen auf die Auslösung von Eklampsie und Präeklampsie, Zentrbl. Gynäk. 66:196, 1942. Berg, H.: Eklampsie und Fronten, Zentrbl. Gynäk. 66:1704, 1942. Petersen, and Milliken, 1b (Reese, H. H.: The Significance of the Meteorologic Environment in the Etiology of Psychotic Episodes, J. Mt. Sinai Hosp. 9:717, 1943. Petersen and Milliken. 1b.

8. Tholuck, H. J.: Selbstmord und Wetter, Beitr. gerichtl. Med. 16:121-151, 1942. Mills. 1c

9. Petersen, W. F., and Mayne, A.: Poliomyelitis and the Meteorological Environment, Acta paediatrica 27:353,1940. De Rudder, B.: Die Wetterauslöslichkeit der akuten Poliomyelitis, Klin. Wchnschr. 20:561, 1941. von Neergard, K.: Zur Meteoropathologie und Reaktionspathologie der Poliomyelitis, ibid. 21:1025-1030, 1942. Bowerman, W. G.: Acute Anterior-Poliomyelitis: A Statistical Survey of the Influence of Weather on Its Evidence, Arch. Pediat. 62:57, 1945. Zingg, T.: Witterung und Poliomyelitis, Schweiz. med. Wchnschr. 75:334, 1945.

10. De Rudder, B., and Petersen, G. A.: Steigert körperliche Anstrengung die Disposition zur epidemischen Kinderlähme? Klin. Wchnschr. 17:699-702, 1938. Milzer, A.; Lewin, P., and Levinson, S. O.: Studies on the Influence of Fatigue, Chilling and Trauma on Experimental Poliomyelitis, J. Bacteriol. 45: 78-79, 1943; 47:467-468, 1944.

jects without considerable gaps. Despite this short-coming, which makes a statistical analysis difficult, the results are rather suggestive and indicate a correlation between daily muscle strength and front passages.

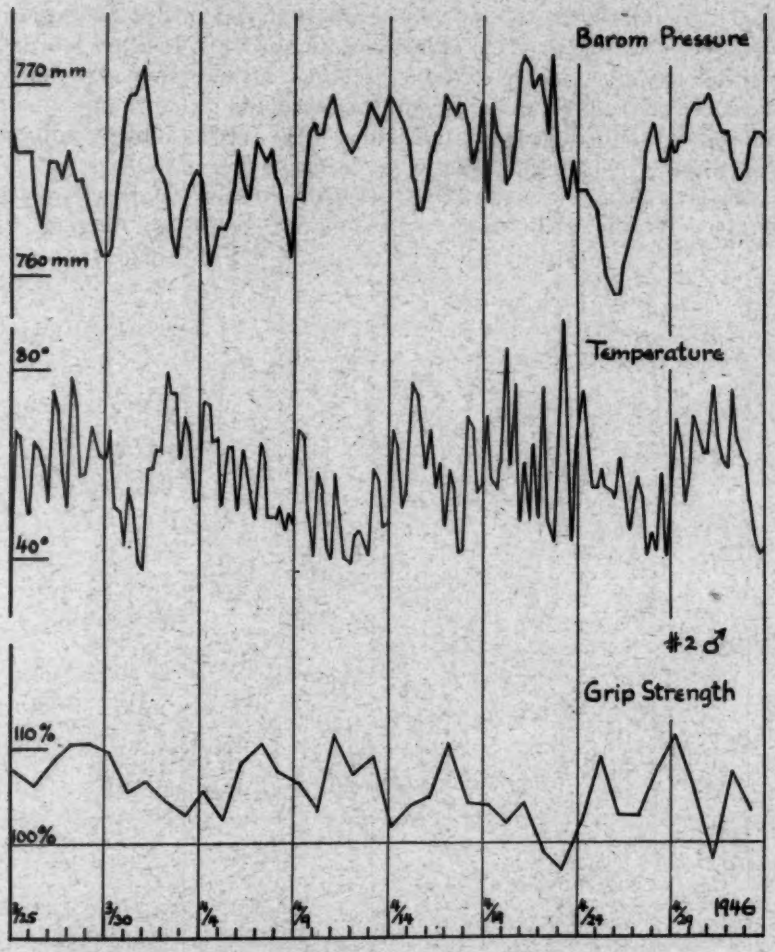

Chart 1. — Barometric pressure (upper curve) and temperature (middle curve) according to data of four readings daily (1:30 a. m., 7:30 a. m., 1:30 p. m. and 7:30 p. m.) as supplied by the Richmond Station, United States Weather Bureau. Lower curve: combined left and right grip strength of a male subject, age 49. Grip strength expressed in per cent of the average grip strength as observed during nine months. Average strength left hand 38.36 Kg., right hand 39.64 Kg.

The subjects gripped with maximal efforts a Smedley hand dynamometer ten times in succession, at first with one hand and then with the other hand. The readings were written down on prepared sheets containing space for remarks pertaining to factors which might have influenced the readings for that day, such as injuries to hand, sleepless night, etc. The subjects repeated the measurements from day to day, if possible at the same time of the day. A ten repetition effort was chosen, since, at least theoretically, the strength of a single effort is affected much more by chance than the average of ten repetitions. On the other hand, ten consecutive maximal grips of a normal subject show little staircase effect and seldom distinct fatigue. The statistical study of Duvall, Houtz and Hellebrandt,[11] performed on these data, revealed that the grip dynamometer is a reliable test and that even a

11. Duval, E. N.; Houtz, S. J., and Hellebrandt, F. A.: Reliability of the Single Effort Muscle Test, Arch. Phys. Med. 28:213 (April) 1947.

single effort test is nearly as good as a ten repetition test. To minimize complications by training effects, the observations for the first ten days for each subject were not included in the evaluation. Later increases in weekly or monthly averages are much smaller than the observed daily variations.

Since it is impossible to reproduce the material in full extent, even for a single subject, only typical examples can be shown. In the records of some subjects the influence of the weather seemed rather marked, while in other records such an influence could not be detected at all. As a rule, daily weather changes during April and May, 1946 were of little influence compared with the effect of the weather at other times.

Typical for little or no relation between weather and daily variation in grip strength is the record shown in chart 1, covering the end of March

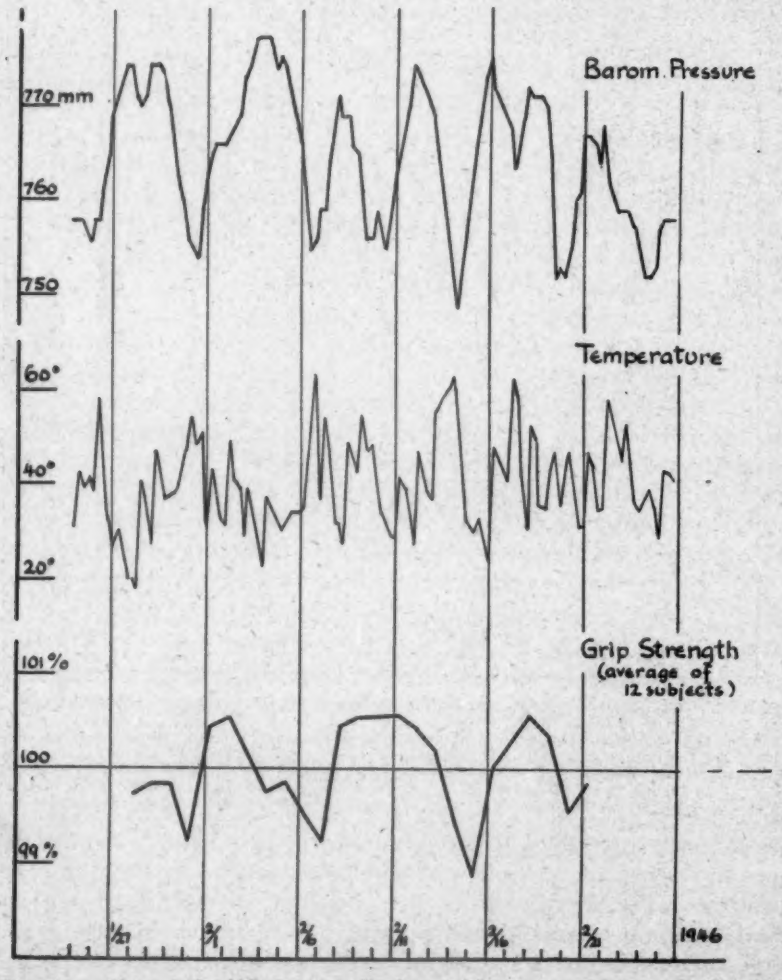

Chart 2. — Upper and middle curve as in chart 1. Lower curve: average muscle grip strength of 12 subjects (2 males, 10 females) expressed in per cent of the average grip strength of the group observed during the period represented here.

and April, 1946 for a subject who had shown a distinct relationship earlier. However, if one is biased, one can read into the record a decrease in strength during the passing of warm fronts on April 1 and 2 and on April 14 and 15 and a similar decline in strength for the smaller meteorologic disturbance on April 8, while during the slow passing of a cold front from April 21 to 25 a decrease in strength is followed by an increase.

In contrast to the records for April and May, the records for February revealed for nearly all subjects a distinct correlation between cyclonic disturbances and grip strength. Despite the fact that not all subjects reacted in an identical manner, the daily average grip strength for all 12 subjects under observation at that time shows distinct correlation with the weather changes (chart 2). During this period, Richmond was hit four times by the

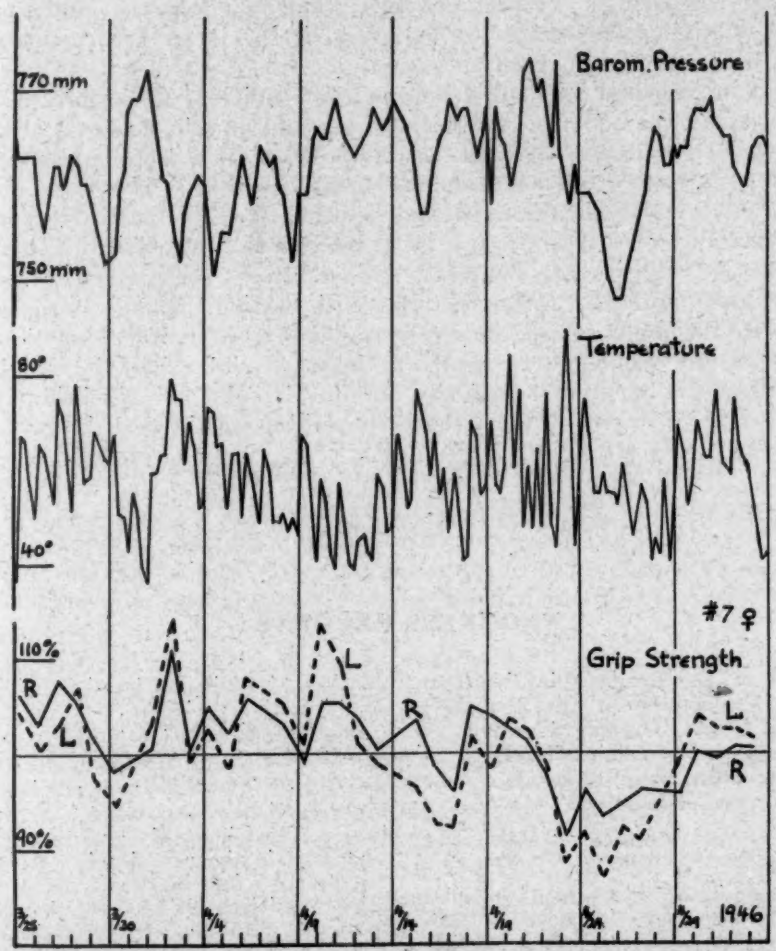

Chart 3. — Upper and middle curve as in chart 1. Lower curve: grip strength for left and for right hand of a female subject, age 24. Grip strength expressed in per cent of the average grip strength of each hand as observed during nine months. Subject had poliomyelitis at the age of 3. Muscle weakness of left arm and leg. Average strength of left hand 12.75 Kg., right hand 25.36 Kg.

tails of hurricanes coming up from the Caribbean Sea. Each passing of such a warm front finds its counterpart in a deep trough of the grip curve. Only the small warm front setting in on April 9, which was due to a more local meteorologic disturbance with much smaller wind velocities, failed to influence the grip curve. Unfortunately, many gaps in the individual records existed before January 28 and after February 23, so that the grip curve could not be extended.

The record of chart 3 covers the same period as the record of chart 1, but represents a subject who shows, even for this generally little effective period, distinct correlation between grip curve and the larger changes in barometric pressure and in temperature. The subject had severe poliomye-

litis twenty-one years ago at the age of 3 years. The absolute grip strength of the left hand is only about 50 per cent of that of the right hand. Considering the extensive muscle atrophy this subject has, her control and coordination of the movements of the affected limbs, as well as the power of these movements, is remarkable, and probably possible only by use of maximal efforts and attention, utilizing all emergency capacities of the organism. This may be the reason that this subject is especially subjective to the excess burden of weather changes. The fact that the damaged left hand shows higher amplitudes of variation, if the latter are calculated in per cent, lends support to such an assumption.

The data collected up to this time are not sufficient to permit any final statement about the effect of weather changes and muscle strength, although they are rather indicative that the weather represents a factor of significant importance, at least from a theoretical point of view. However, such a relation between muscle strength and weather may be partly responsible for the observations of Huntington[12] that the mechanical efficiency and work production in factories are distinctly influenced by the passing of fronts. My experience with the former poliomyelitis patient, who was especially sensitive to the meteorologic changes, suggests also another practical importance of the problem. It seems at least possible that the results of muscle testing as performed clinically on convalescent poliomyelitis patients are appreciably affected by the weather prevailing on the test day.

12. Huntington, E.: Civilization and Climate, ed. 3, New Haven, Conn., Yale University Press, 1924.

PROGRESS REPORTS

A Report of the Progress in the Two Years Development of the Department, of the Organization and Integration of Clinical Physical Medicine, Research and Education *

By William B. Snow, Columbia University College of Physicians and Surgeons, New York.

Under the original Baruch grant, Columbia University was the recipient of $400,000 for the development as a center of physical medicine. Such a center should serve the primary function of reesarch and education in physical medicine and should develop methods which would serve as a model for other centers. The acceptance of these funds enables us to pursue with more forcefulness certain fundamental developments in the field which at Columbia presbyterian Medical Center have been slowly progressing for the past ten years.

The program of physical medicine is now developing in cooperation with a primary committee, of which the Dean of the Medical School is the chairman, which will advise on research and education. Another committee in the hospital continues as in the past to advise on hospital, clinic and administrative problems.

The improvement in physical therapy at our Medical Center and the appreciation of the hospital medical and administrative staffs of what we are trying to accomplish have resulted in steady growth of the departments in the past decade. At present we employ 1 full-time and 5 part-time salaried physicians, 24 physical therapists, 7 masseurs, 3 nurses, 3 secretaries and 1 clinical aide at the Medical Center and 8 physical therapists in the orthopedic division. In addition, there are 13 occupational therapists, giving a total of 65 personnel. The hospital expenditures in physical and occupational therapy for 1945 were over $121,000, of which 83 per cent was recovered. This is the normal development of a realistic attitude toward physical medicine.

We have much more need for staff education at the Medical Center. Each of our staff physicians in physical medicine at present is taxed to the extreme in keeping up with the demands we have placed on ourselves, to maintain our service and carry out our responsibilities in the educational program.

(*Continued on page 304*)

* Abstract of a paper read at the Twenty-Fourth Annual Meeting of the American Congress of Physical Medicine, New York, Sept. 6, 1946.

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∴ EDITORIALS ∴

TRENDS IN TRAINING IN PHYSICAL MEDICINE*

During World War II the concepts of medical rehabilitation were given new impetus and attained a greater place in the field of therapeutics than ever before. It is well to recall that during World War I there had been a well organized attempt at what was then known as the "Reconstruction Service," but early in the 1920's this service was cut back to routine physical therapy and occupational therapy. At the present time, there is increasing interest in medical rehabilitation, particularly in the Army and in the Veterans Administration. Examination of the various components of this present concept and particular reference to the relationship between physical therapy and corrective physical rehabilitation (physical reconditioning) may prove of value in order to assay the situation as it now stands and to point out certain general trends which may be followed in the future.

It is safe to assume that medical rehabilitation is becoming a recognized "third phase" of medicine. It is extremely doubtful that even a serious economic recession could do worse than retard the growth of this third phase of medicine—the likelihood of its being abandoned as after first World War is minimal.

As currently established in the Veterans Administration, medical rehabilitation is comprised of two major sections: physical medicine and retraining. Under physical medicine come physical therapy, occupational therapy and corrective physical rehabilitation. Under retraining come educational retraining and shop retraining (soon to be called manual arts therapy). Also it would be well to call attention to the fact that related fields, such as social service, vocational advisement, special services and many others, are closely coordinated with medical rehabilitation. Obviously, too, medical rehabilitation is coordinated with the medical and surgical services in such a manner that the patients are assured the maximum benefits at the earliest practicable time after their admission to the hospital. It is not within the scope of this article to take up in more detail the valuable role played by retraining or by occupational therapy.

At the present time there exists a considerable degree of confusion as to the relationship between physical therapy and corrective physical rehabilitation (P. R.). There have been various attempts made to clarify the sphere of influence of each and to set the limits where physical therapy ends and corrective physical rehabilitation (P. R.) begins. For example: It has been stated that physical therapy treats the injured portion of the body while corrective physical rehabilitation (P. R.) treats the uninjured or unaffected parts. Another attempt was made when it was stated that physical therapy would do passive exercise while corrective physical rehabilitation (P. R.) would do active exercise. Such types of clarification are noteworthy be-

* By Ben L. Boynton, M.D., Director of Physical Medicine, Shannon Memorial Hospital, San Angelo, Texas; Branch Section Chief, Physical Medicine, Branch Office No. 10, Veterans Administration, Dallas, Texas; Consultant in Physical Medicine to Surgeon General for Fourth Army Area, Ft. Sam Houston, Texas.

cause they show the utter futility of trying to separate the inseparable functions of this important phase of physical medicine. Basically, corrective physical rehabilitation (P. R.) is the result of applied physical education to the problem of the patient who is physically under par or to the patient who is to be prevented from becoming deconditioned due to hospitalization. This may also be said of the therapeutic exercise program in physical therapy, which, though it has been sadly neglected in teaching and in practice, nevertheless, encompasses the same basic principles. It should be clear to all that physical therapy by a simple process of expansion in training and practice could adequately assume the bulk of the work which is now being done by corrective physical rehabilitation (P. R.). Examination of some of the borderline cases may prove illustrative of the fact that physical therapy and corrective physical rehabilitation (P. R.) are inseparable. What part of the hemiplegic rehabilitation program is to be done by physical therapy and what part by corrective physical rehabilitation (P. R.)? In hospital "A" physical therapy is carrying the full load; in hospital "B" physical therapy gives only heat and hydrotherapy, and all muscle retraining and reeducation in walking is given by corrective physical rehabilitation (P. R.). This disparity is due not at all to differences in policy but rather to the fact that in hospital "A" there are an adequate number of physical therapists while in hospital "B" there is only one Physical Therapist but there are two or three corrective physical rehabilitation (P. R.) men. Much confusion existed in the Army during the early phase of the Amputee Walking program—in some hospitals this training was given by physical therapists; in others, by physical reconditioning personnel. This state of confusion was quickly resolved by a directive from the Surgeon General which placed the full responsibility for this important task on the shoulders of physical therapy and thus attained a uniform program, the results of which are one of the high points of physical medicine in World War II. Currently, there exists confusion regarding whose job it is to train paraplegics to walk, and again there is overlapping in the therapeutic approach. It seems self evident that, in truth, physical therapy and corrective physical rehabilitation (P. R.) are inseparable and in the practical application of these measures the best results are obtained where there is the closest integration of the two, both from the standpoint of physical layout and from the standpoint of complete understanding by personnel in both as to the problems faced by the other.

From a purely economic standpoint it appears evident that in time of depression physical therapy will be called on to take over much of the function now being performed by corrective physical rehabilitation (P. R.) as well as to carry on with what is currently considered physical therapy in its narrower sense. Also from a purely economic point of view, in civilian hospitals physical therapists are called on to perform many of the functions that are given to corrective physical rehabilitation (P. R.) in the Veterans Administration and to Physical Reconditioning personnel in the Army. It is doubtful that in the very near future there will be a well recognized place for personnel trained solely in the field of Corrective Physical Rehabilitation (P. R.) in any great number of civilian institutions.

With the advent of highly ethical technical associations and high professional and educational standards for schools in physical therapy, recognition of qualified physical therapists was forthcoming and their certification has been accomplished. To attain independently the same high professional recognition for corrective physical rehabilitation (P. R.) personnel will mean a period of five to fifteen years during which time much effort and great expense must be put forth to set up standards, staff schools and educate the

medical profession as to the proper utilization of personnel so trained. Therefore, why would it not be a wiser move to make use of existing training facilities in physical therapy, enlarging on the scope of physical therapy to give the necessary time to particular training in physical reconditioning and perhaps develop both in training and in practice two major divisions of physical therapy. One division would devote its time to electrotherapy, light therapy and hydrotherapy, while the other division would carry out the functions now considered under the heading of corrective physical rehabilitation or physical reconditioning. However, personnel in each division would be thoroughly capable of functioning in either, and, furthermore, would have at all times a keen appreciation of the job the other division is doing. This concept of "union now" has as its main objective improved physical medicine service to the patient and, secondly, implementation of the broadened aspect of physical therapy in civilian hospitals.

A few words concerning the problem in civilian institutions may be a value. For a number of years physical therapy has been largely confined to electrotherapy, light therapy and hydrotherapy, with, of course, massage and mechanotherapy. In a few hospitals there has been considerable emphasis on therapeutic exercise, but in many more this important phase of physical therapy has been considerably neglected; especially is this true of bed exercise. While most persons will agree that it is highly desirable to have a trained physiatrist in charge of physical medicine in all hospitals, the fact remains that there is a great paucity of men so trained. Therefore in many hospitals, the physical therapy department is headed by a physical therapist who works under orders from various referring physicians. It is difficult to see at this time how corrective physical rehabilitation (P. R.) personnel who are not qualified physical therapists and who lack the necessary training in pathology can be integrated readily into a hospital where there is no physiatrist. Furthermore in a large majority of civilian hospitals with two hundred beds or less, there is not sufficient corrective physical rehabilitation (P. R.) being done to require a full-time person in that field. However, a person trained in both physical therapy and corrective physical rehabilitation (P. R.) is exceedingly valuable and has a greater usefulness than one trained solely in Physical Therapy.

In summary, then, a plea is being made to attain the following ends: (1) broadening of the scope of physical therapy to include the two phases currently being called physical therapy and corrective physical rehabilitation (P. R); (2) training of personnel in physical and reconditioning therapy so that both divisions may have equal professional standing and understanding; (3) with such broadened training, greater utilization of physical reconditioning in hospitals and consequently greater opportunities for both men and women properly trained.

As to personnel now at work in Army and Veterans Administration hospitals, it is to be hoped that opportunity will be given for such additional training in either phase, as will qualify them for adequate performance and certification in both.

It is felt that basic training in physical medicine should include orientation in the whole field—i. e., physical and reconditioning therapy as well as a survey of the principles and practice of occupational therapy. This should be followed by specific training in physical and reconditioning therapy to the ultimate goal of certification in and professional recognition of such training. A program of this sort is professionally and economically sound and will promote still greater utilization of physical medicine in the coming years.

PROGRESS REPORTS

(Continued from page 300)

Our present primary problem is the education of attending staff, house staff and physical medicine residents, and the orientation of nursing groups and medical students to physical medicine, along with the training of physical and occupational therapists.

Our second need is improvement of service to patients and the bringing of physical treatment to more patients who need such care. Much of this will follow as the direct result of the better follow-up made possible by established residencies in physical medicine, along with continued energetic staff education.

The third point we are stressing is the development of occupational therapy under direct medical supervision, eliminating all nonessential diversional occupational therapy and stressing functional prescriptions and strong psychiatric occupational therapy.

Lastly, practical physical medicine in the hospital and clinics is being integrated with the educational and research projects going on, under the supervision of the medical school. Staff integration between instructors, therapists and students is being encouraged to further the plan.

Dr. Robert Darling has been appointed research director. He now has a well equipped laboratory and is counseling on research problems and acquainting himself generally with the field of physical medicine. Several research problems were started and are continuing in the department of physiology. Preliminary reports of some of these are being presented at this meeting.

Further researches will develop in direct relationship to the program for residents in physical medicine now inaugurated. We look forward to these residents for:

1. Improving general hospital and clinical staff orientation to the value of Physical Medicine in helping patients to get well.

2. Supplying the great need for continuous follow-up of all inpatients who otherwise could not be seen each day except by the therapists.

3. Assisting therapists with on-the-spot medical assistance.

4. Establishing rapport with residents in other departments in carrying out the necessary integration of physical medicine with other therapy.

5. Lifting a considerable responsibility from the attending physicians in Physical Medicine and allowing them more time for advisory, consulting, and teaching work.

6. Representing physical medicine at miscellaneous staff medical, surgical and pediatric conferences.

7. Preparing cases receiving physical medicine for presentation at Physical Medicine Rounds.

Eight physical medicine residencies have been established by Columbia University. These residencies are for the duration of sixteen months, divided into four months of intensive didactic instruction, case demonstration and theoretical considerations, and twelve months of active work in the affiliated hospital to which staff the residents are appointed, working under the director of physical medicine at that hospital. The residency will prepare them for fellowships offered by the medical school. These fellowships are annually renewable and cover complete maintenance. It is hoped that these fellows will devote two years beyond the residency period. During this period it is possible for these men to qualify for a Doctor of Medical Science degree at Columbia University. The present residency plan will undoubtedly be improved, and, while working under fellowship grant, these doctors will enter into research problems, do a considerable amount of undergraduate teaching, secure administrative experience and be guided under a postgraduate medical program at the medical school. Such a program of postgraduate training in physical medicine will prepare these men for specialization and fit them for heading up similar training programs in physical medicine at other universities.

The training courses for therapists in occupational therapy and physical therapy have been moved from the department of extension to the College of Physicians and Surgeons. A Bachelor of Science degree in physical or occupational therapy is offered for undergraduate candidates who are admitted with 60 liberal arts credits after completion of two years of didactic and practical work. Certificates in occupational therapy and physical therapy are offered to graduate students with appropriate preliminary training after completion of one year of intensive training.

The medical students at Columbia University get no specific course in physical medicine, but, in connection with pediatrics, orthopedics and dermatology and syphilology, they get orientation lectures in physical medicine as applied in these specialties. It is a question how much more is necessary or advisable to give in the undergraduate medical studies, now already almost too heavy for a four year training course.

Monthly joint conferences between the physical therapy and occupational therapy department operating in the hospital and the students in occupational therapy and physical therapy have been correlated.

Regular monthly showings of films on

subjects related to physical medicine are given and announced in advance to the entire staff of the Medical Center, both hospital and college.

Occupatonal therapy has been definitely united with physical therapy in one department. The occupational therapy staff has been completely reorganized and is under direct medical supervision. Salaries of occupational therapists have been brought directly in line with those of physical therapists. Staff education has been stressed. The occupational therapy shops have undergone complete revision and been brought up to date. New equipment stressing improvement in function has been added, and in rehabilitation we are thinking in terms of the restoration cupational requirements as possible.

The Medical Center, erected in 1929, has been continually expanding in function and resources and is at present due for a considerable amount of rejuvenation. Building plans are being formulated, and in these plans provision for expansion and improvement of facilities for physical medicine are being made consistent with this over-all development.

Physical therapy at the Columbia Presbyterian Medical Center is constantly available over a twenty-four hour period including Sundays and holidays.

Many of the conditions we treat can be measured and photographed. Adequacy, clarity, simplicity, ease of recording and saving of time have been our aims in the preparation of new record forms.

Many patients, such as those arthritic and chronic neurological conditions, convalescent patients and other patients bedfast or invalided, require the attention of physical and occupational therapists in their homes. How can such service be safely provided with continuous medical supervision and kept in the hands of well trained ethical therapists? Some thinking is needed in this area.

The problems of poliomyelitis, posture and cerebral palsy are receiving a good deal of consideration as we are developing our program. Particularly has the problem of cerebral palsy been brought into sharp focus, for we have had four distinct groups at the Medical Center interested in the care of these patients. A special committee is exploring the integration of these groups with consideration of socialization, education, adequate medical care, physical training toward self help and locomotion, psychologic problems and continued guidance to a contented future for these patients.

Total rehabilitation is being carried out at the Medical Center, particularly on the neurologic patients. Plans are being projected for an intramural hospital which will permit us to keep our patients under supervision for a longer period than at present possible in order to complete the rehabilitation if required.

Throughout our work we have constantly been impressed by the thoroughness of the Baruch Committee of Physical Medicine in the over-all planning and their willing cooperation. Other branches of the university have been most helpful in furthering our development. Our greatest asset throughout this development has been the support of Dean Rappleye and his staff. The superintendents and medical boards of our affiliated hospitals have been quick to appreciate our problems and needs and have done all they could to assist us.

All this makes the success of our plans over the next eight years merely a matter of vigorously applying ourselves. Another report will be forthcoming later which will show a fuller realization in the achievement of our objectives.

180 Fort Washington Ave.

ROUND TABLE ON BIOPHYSICS AT MINNEAPOLIS

Readers are requested to submit questions to be discussed at the round table on Biophysics, which is planned as part of the annual session. Please direct your suggestions to Program Committee, American Congress of Physical Medicine, 30 North Michigan Avenue, Chicago 2.

MEDICAL NEWS

Dr. Coulter Reelected to Council

The American Medical Association announces the following who were reelected to the Council on Physical Medicine: Dr. John S. Coulter, Chicago, Chairman; Dr. W. E. Garrey, Nashville, and Dr. W. W. Coblentz, Washington, D. C.

Major Murray B. Ferderber

The Legion of Merit has been awarded to Major Murray B. Ferderber (then Captain), M. C., A. U. S., of Pittsburgh, who was convalescent services officer, Army Air Forces Regional Hospitals, Westover Field, Massachusetts, and Mitchel Field, New York, from March, 1943 until September, 1945. The citation explains that he organized and directed special training courses in physical therapy technics and provided rehabilitation and convalescent care for disabled personnel. Major Ferderber's distinctly meritorious contributions to the convalescent services program reflect great credit on himself and on the armed forces of the United States. Dr. Ferderber graduated from Rush Medical College in 1932 and entered the military service in July, 1942.

Television

Dr. C. O. Molander and a group from the department of Physical Medicine of Michael Reese Hospital, Chicago, with the aid of Mr. Howard Carter, participated in a television broadcast on physical medicine from studios in Chicago.

Physical Medicine at Percy Jones

At the Percy Jones General Hospital weekly conferences on physical medicine were held during the month of April. The following covered the presentations: Apr. 2, Capt. J. J. Keys, "Reconditioning in the Philippine Islands"; Apr. 9, Capt. Catherine Wallace, "Joint Measurement"; Apr. 16, Major G. W. Geiss, "The Use of Ultraviolet Light," and Apr. 23, Miss Mildred Bond, Chief of the Occupational Therapy Section, "Leather and Metal Work in Occupational Therapy."

Colonel William R. Lovelace II

The Legion of Merit has been awarded to Col. William R. Lovelace II, M. C., A. U. S., of Albuquerque, N. M., who was cited as contributing immeasurably to the development of reliable oxygen equipment and efficient litter facilities as chief, Aero Medical Laboratory, Engineering Division, Headquarters, Air Technical Service Command, from September, 1043 to September, 1945. Colonel Lovelace's brilliant achievements, his contributions to medical science and the advancements he made toward aviation medicine reflect the highest credit on himself and on the Army Air Forces.

Colonel Lovelace has also been awarded the Air Medal and the Army Commendation Ribbon. He graduated from Harvard Medical School in 1934 and entered the military service Feb. 15, 1942.

Need at Hines for Physiatrists

There is an urgent need for physiatrists at the Veterans Administration Hospital, Hines, Illinois. This hospital has approximately 3,000 patients. The Physical Medicine Service includes patients from Medical, Surgical, Neuropsychiatric and Tuberculosis Services. If interested, please write to Dr. K. A. Carroll, Manager, stating training, background and experience, in Physical Medicine.

Medical Bills Introduced in State Legislature

California. — A.2078, to amend the business and professions code, proposed to prohibit any one not licensed under that code from using physical medicine in treating the human body of any person for compensation.

Connecticut. — S.285 proposes an act for the regulation of massage practitioners and defines the practice of massage as "any process or action of conjoint motion and pressure applied by hand, such as rubbing, stroking, kneading, tapping or other similar manipulation, with or without the application of creams, lotions or liniments or the use of hand vibrators or rollers to any part of the human body for the purpose of relieving pains, aches, stiffness or soreness of muscles or for the purpose of stimulating blood circulation or reducing conditions of obesity, including the use of vapor treatments and any and all other manual means, such as physical exercises for the conditioning of the human body."

Minnesota. — S.572 proposes certain amendments to the osteopathic law which would create a state osteopathic board of examiners in medicine and surgery and would define osteopathy as "a complete school of medicine based upon the osteopathic concept which is different in emphasis from those principles recognized by other schools of medicine." The proposal would grant to osteopaths identical privileges with those now possessed by general practitioners.

New Mexico. — H.148 proposes the creation of a board of naturopathic physicians and defines naturopathy as follows: "The term 'Naturopathy' as used herein shall comprehend, embrace and be composed of the following named acts, practices and usages, as set forth in the Act of Congress of the United States, enacted Feb. 7, 1931, H. R. 12169 defining Naturopathy, Diagnosis and Practice of physiological and material

sciences of healing as follows.—The physiological and mechanical sciences such as mechanotherapy, articular manipulation, corrective orthopedic gymnastics, neurotherapy, psycho-therapy, hydrotherapy, and mineral baths, electrotherapy, thermotherapy, phototherapy, chromotherapy, vibrotherapy, thalmotherapy, and dietetics which shall include the use of foods of such biochemical tissue-building products and cell salts as are found in the normal body; and the use of vegetal oils and dehydrated and pulverized fruits, flowers, seeds, barks, herbs, roots, and vegetables uncompounded and in their natural state.—[J. A. M. A. 133:700 (Mar. 8), 1947.]

Schools for Physical Therapy Technicians *

The House of Delegates of the American Medical Association in 1934 requested that some plan be effected for the establishment of standards, ratings and inspections of schools for the training of physical therapy technicians. The Council on Medical Education and Hospitals assumed responsibility for this program and by 1936 had completed a survey of these schools. Certain minimum standards were formulated. These were presented to the House of Delegates of the American Medical Association and were ratified in May, 1936. The first published list of 13 approved schools appeared in The Journal in August, 1936.

Three schools have been approved during 1946, and the total now is 24. These accredited centers have a capacity of 567 students and produced 507 graduates last year from the regular course. If we add the 250 emergency course students who completed their requirements for certification in 1946, the total graduates are well above 750. This figure compares favorably with the 1945 record number of 786 graduates, which included the emergency students who were certified in that year. The so-called emergency course was designed to aid the armed services in acquiring large numbers of trained personnel who could work under supervision and complete requirements for certification.

Entrance requirements demand a background of graduate nurse, graduate in physical education or collegiate training with science courses. Seventeen schools admit nurses, 14 accept physical education graduates and all but 2 schools will permit college students to enroll in the one year curriculum. Entrance requirements listing college training contain 13 that specify three years of college credits and 10 which mention two years of credits, while 4 require a degree. A total of seven courses are combined with college curriculums, so that high school graduates can obtain a degree in physical therapy after four academic years of study. All but 7 of the schools offer college credits, although 2 schools which list two courses state that only one course will permit the student to accumulate college credit.

The length of training is twelve months in most instances, but three require fourteen, fifteen and twenty-four months, respectively, for the regular course, while high school graduates must complete the four year program.

* Rep. J. A. M. A. 133:1149 (April 12) 1947.

Physical and Occupational Therapists in Hospitals *

	Physical Therapists		Occupational Therapists	
	Full Time	Part Time	Full Time	Part Time
Alabama	31	11	28	7
Arizona	22	3	12	2
Arkansas	30	6	18	....
California	343	49	154	42
Colorado	67	19	31	14
Connecticut	57	12	82	17
Delaware	11	....	11	....
District of Columbia	51	....	43	3
Florida	54	4	19	1
Georgia	65	6	30	2
Idaho	5	5	3	1
Illinois	250	33	185	12
Indiana	67	4	70	6
Iowa	45	8	36	2
Kansas	38	8	35	5
Kentucky	25	8	38	1
Louisiana	31	2	15	2
Maine	19	5	11	1
Maryland	59	12	61	9
Massachusetts	134	22	152	9
Michigan	131	11	137	12
Minnesota	87	9	52	6
Mississippi	19	2	32	1
Missouri	80	18	33	3
Montana	13	3	1	5
Nebraska	16	10	10	1
Nevada	2	2	.....	1
New Hampshire	5	7	8	1
New Jersey	132	23	122	9
New Mexico	11	1	15	....
New York	504	89	522	25
North Carolina	50	9	25	5
North Dakota	6	3	4	....
Ohio	124	20	87	14
Oklahoma	20	9	14	1
Oregon	23	1	15	2
Pennsylvania	226	47	131	20
Rhode Island	16	3	21	2
South Carolina	8	2	3	1
South Dakota	14	3	15	1
Tennessee	37	4	21	2
Texas	170	12	105	6
Utah	13	2	2	....
Vermont	10	2	8	1
Virginia	67	4	56	8
Washington	87	8	51	2
West Virginia	26	3	13	2
Wisconsin	79	19	55	4
Wyoming	11	3	9	1
Totals (1946)	3,391	546	2,601	272
(1945)	3,716	583	2,902	322
(1944)	3,220	747	2,266	346
(1943)	2,905	719	1,883	351
(1942)	2,643	772	1,727	283
(1941)	2,505	602	1,882	350
(1936)	2,382		1,809	

* Rep. J. A. M. A. 133:1077 (April 12) 1947.

The Kenfield Memorial Fund

A sum of money was subscribed in 1937 in memory of Miss Coralie N. Kenfield of San Francisco, a teacher who was known throughout the United States for her methods in teaching lip reading. This money was placed in the Kenfield Memorial Fund. The interest provides a scholarship known as the Coralie Noyes Kenfield Scholarship for Teachers' Training Courses for Teachers of Hard of Hearing Adults. Applications will be considered from any prospective hard of hearing teacher of lip reading to hard of hearing adults who lives in the United States and who can meet the requirements. Applications which must be filed before June 1, 1947, can be requested from the American Hearing Society, 1537 35th Street, N. W., Washington 7, D. C.

Schools for Occupational Therapy Technicians *

At the 1933 session of the House of Delegates of the American Medical Association a resolution was introduced that some plans be effected for the establishment of standards, ratings and inspections of training schools for occupational therapy technicians. This program was referred to the Council on Medical Education and Hospitals, and all of the 13 existing schools were surveyed. The Essentials of an Acceptable School of Occupational Therapy were ratified by the House of Delegates of the American Medical Association at the Atlantic City session in 1935, such standards to become effective on Jan. 1, 1939. A report of the Council on Medical Education and Hospitals to the House of Delegates in 1936 contained the names of 4 schools which had already met these standards. There are currently 18 schools on the approved list.

The approved schools present twenty-seven curriculums and three advanced standing courses. Entrance requirements vary according to the curriculum, with twelve designed for high school graduates, who are expected to devote four or five academic years to complete the combined college and professional subjects. Seven of the curriculums require one year of college as a prerequisite, while two prescribe two years of college credits and six specify that a degree is necessary.

There is a correlation between the length of training and entrance requirements among the various curriculums. Those that require a college degree usually enable the student to complete all work in two years, but 1 school presents three academic years of subjects in the course designed for college graduates.

All the approved schools are affiliated with recognized colleges, and twenty-five of the curriculums enable the student to acquire college credit. The amount of college credits available vary from about one semester in some of the shorter courses to 128 semester hours. Thus, degrees are granted by 16 schools and a diploma or certificate is presented by the other 2 schools. The curriculums which are shorter than the basic course are designed for a certificate or diploma when the student completes all requirements.

Tuition ranges between $21 and $550 per year. These amounts, are, of course, determined by university fees, and there is no instance in which a certificate course fee exceeds the fee for a degree course. The mean tuition is $200.

A total of 375 graduates were reported in 1946 from the twenty-seven curriculums mentioned, while 16 students completed the advanced standing course. These graduates represent 44 per cent and 70 per cent, respectively, of the maximum capacity of the two programs. However, if the 220 War Emergency Course students who were mentioned in last year's report and who apparently completed all requirements for certification are added to this year's graduates it is apparent that 611 is the corrected total for the 1946 graduating classes.

Four new schools that present six curriculums have complied with requirements and are now ready for inspection. It is anticipated that these schools will be added to the approved list soon. Two additional schools have developed curriculums and will be ready for inspection next year.

It is anticipated that the approved schools will graduate 418 students in 1947 plus 17 from the 4 that are ready for inspection and 23 from the advanced standing courses. Thus, about 458 graduates can be expected next year. This number is necessarily smaller than the two last years' experience because all the war emergency students have completed their requirements by now and about 200 to 250 fewer graduates will be expected each years.

* Rep. J. A. M. A 133:1148 (April 12) 1947.

The Journal and the British Association of Physical Medicine *

This number marks an epoch in the history of the publication because henceforth the Journal becomes the official organ of the British Association of Physical Medicine. It has been decided that the editorial policy and responsibility shall be jointly that of the Association and of the Publishers. In accordance with this decision the editorial personnel now consists of one Member of the British Association of Physical Medicine selected by the Council, Dr. Matthew Ray, and the Medical Publishing Editor of Butterworth & Co. The editors will be assisted by an Editorial Committee, consisting of Dr. F. Bach, Dr. P. Bauwens and Dr. G. D. Kersley.

The objects of the Association are as follows: 1. To promote a more general appreciation of the value of physical medicine in the prevention and relief of human suffering and to implement measures by which physical medicine may attain the highest standard of efficiency and be used effectively for the achievement and maintenance of physical fitness. 2. To study and stimulatemet hods of restoring efficiency following disease and dis-

* Horder, Brit. J. Phys Med. 10:11 (Jan.-Feb.) 1947.

ability, with special reference to rehabilitation and the rheumatic diseases. 3. To encourage the study of the action of physical agents and their application in the promotion of health, in the prevention and treatment of illness and injury, and in the restoration to fitness. 4. To stimulate scientific research in any aspect of physical medicine. 5. To evaluate apparatus and methods claimed to be useful in physical medicine. 6. To encourage within the medical profession undergraduate and postgraduate training in all aspects of physical medicine. 7. To provide opportunities for members to discuss matters appertaining to physical medicine. 8. To work in cooperation with other organizations in the pursuit of similar objects.

Postgraduate Course at Meharry Medical College

Meharry Medical College, Nashville, Tennessee, arranged for the first time a course in physical medicine, April 21 to 24, 1947, conducted by Dr. Richard Kovács and assisted by members of the medical staff: Drs. M. M. Cox and J. R. Lawson, also by Miss Marjorie Franklin and Mrs. Yolande Johnson.

Dr. Kovács also spoke April 21 to a meeting of the staff of the Veterans Hospital and the attending and consultant groups of Vanderbilt University of Nashville.

BOOK REVIEWS

THE 1946 YEAR BOOK OF PHYSICAL MEDICINE. Edited by *Richard Kovács,* M.D., Professor of Physical Medicine, New York Polyclinic Medical School and Hospital; Attending Physical Therapist, Manhattan State, Harlem Valley State, Columbus and West Side Hospitals; Visiting Physical Therapist, New York City Department of Correction Hospitals; Consulting Physical Therapist, New York Infirmary for Women and Children, Mary Immaculate Hospital, Jamaica, N. Y.; St. Charles Hospital, Port Jefferson, L. I., Hackensack Hospital, Hackensack, N. J., and Alexian Brothers Hospital, Elizabeth, N. J., Senior Consultant in Physical Medicine and Medical Rehabilitation, Veterans Administration. Cloth. Pp. 399 with 135 illustrations. Price, $3.75. Chicago: The Year Book Publishers, Inc, 1947.

This 1946 Year Book of Physical Medicine shows that it has made considerable advances in 1946 in its general status as well as in research. In the clinical application of physical application Kovács shows that many of the activities carried on and much of the progress reported have dealt with wartime and postwar physical rehabilitation. The papers in this volume show that there seems a definite tendency to apply wartime experience to civilian practice with a view to shortening convalescence.

Kovács shows that although the clinical use of physical medicine steadily broadened during the war years, there have been relatively few new developments in its methods. Among these are improved and simplified forms of apparatus and prosthetic devices and increasingly efficient types of exercises and specific procedures for convalescent care. The physiologic aspects of basic methods in physical medicine electrodiagnosis and the electrical correlates of nerve injuries also receive considerable attention.

The illustrations are excellent and numerous. The subject material is presented clearly and concisely. The approach is scholarly. This book should be in the library of every general practitioner and is of vital interest to every physician interested in physical medicine.

THE PRINCIPLES OF NEUROLOGICAL SURGERY. By *Loyal Davis,* M.S., M.D., F.A.C.S., Ph.D., D.Sc. (Hon.), Professor of Surgery and Chairman of the Division of Surgery, Northwestern University Medical School, Chicago, Illinois. Third Edition. Cloth. Pp. 540, with 192 engravings containing 348 illustrations. Price, $7.50. Philadelphia: Lea & Febiger, 1946.

This work shows physicians and students the possibilities of neurologic surgery. It gives easily assimilable facts that will clarify their concept of neurologic surgery and enable them to give their patients more accurate and sound advice. It should be valuable to physicians and students interested in physical medicine for Davis says: "It is unfortunate that many times nerve ends are sutured and no thought is given to what we consider to be at least of as great importance: carefully supervised and persistent physical therapeutic after-care. If the paralyzed muscles are allowed to shorten and contract or the joints become ankylosed or fibrosed, it is of little value to have sutured a nerve and have its fibers regenerate. Every effort must be directed toward restoration of the normal physiological function of the paralyzed muscles. Although it is somewhat difficult to measure accurately, we are firmly convinced that those patients who receive physical therapy show evidences of recovery of function much earlier, and the degree of recovery is much greater."

This new edition is of great aid in the diagnosis of all neurologic conditions. It covers fully craniocerebral injuries, intracranial tumors and abscesses, the surgical lesions of the cranial nerves, injuries of the spinal cord and peripheral nerves,

tumors of the skull and spinal cord and the surgery of the autonomic nervous system. Such topics as pain and the surgical treatment of epileptiform seizures, paralysis agitans and the psychoses are covered. It is highly recommended to students and physicians.

HARVEY CUSHING. A BIOGRAPHY. By *John F. Fulton.* Cloth. Pp. 755, with illustrations. Price, $5.00. Springfield, Ill.: Charles C. Thomas, 1946.

The youngest of ten children, Harvey Cushing was the third generation of physicians. Most of us know Cushing for his fame as a brain surgeon. Yet to bring his biography within the compass of a single volume, there has been deliberately curtailed the more technical phases of neurosurgery and brain tumor pathology. Of interest to physiatrists is that part which deals with electrosurgical procedures and we quote:

> Sometime in the spring or summer of 1926 Cushing's interest was drawn to the possibilities of using high frequency currents to assist with the more vascular tumors and in July he consulted the physicist attached to the Harvard Cancer Commission, Dr. W. T. Bovie, who had developed two separate high frequency circuits to aid in removing cancerous growths, one designed to cut tissue without bleeding, and the other to coagulate, for example, a vein that had to be severed or a vessel already open and bleeding. Cushing and Bovie experimented with these currents and they developed various loops, balls, and steel points which could be attached to a sterilizable handle for use in applying the current to cerebral tissue. The next day (after the first operation) H. C. wrote to Bovie, "In spite of the confusion of our many-ringed circus I was delighted to see how well the loop worked. If I could have had it at the first stage, I would have got along as far as I have now in this stage." The case in question was one of a highly vascular myeloma. After several months' further trial with the unit which Bovie had devised, the circuits were submitted to the Liebel Flarsheim Company for commercial construction. Mr. Liebel, the head of the firm, took a personal interest in the development and as a pilot in his own right he few his plane back and forth to Boston on many occasions while the new equipment was being perfected and presented H. C. with the first unit.

Attention is also called to the late W. L. Clark, one of the Presidents of the American Congress who in 1911 published an article on "Oscillatory desiccation in the treatment of accessible malignant growth and minor surgical conditions. A new electrical effect." It was during Dr. Clark's term of office that Cushing was awarded by the Congress its Gold Key of Merit.

The book is highly interesting and especially stimulating to all who are interested in the history of medicine and surgery.

THE HEAD, NECK AND TRUNK. MUSCLES AND MOTOR POINTS. By *Daniel P. Quiring,* Ph.D., Head of the Anatomy Division, Cleveland Clinic Foundation and Associate Professor of Biology, Western Reserve University, Cleveland, Ohio. Cloth. Pp. 115, with 103 illustrations. Price, $2.75. Philadelphia: Lea & Febiger, 1947.

This is a companion volume to the author's "The Extremities." It portrays in diagrams and condensed descriptions the striated muscles of the head, neck and trunk. It gives an exact account of the skeletal attachments, nerve, chief arterial supply and functions of these muscles. The diagrams are based on original dissections and on references to the anatomical literature. The muscles of the left side have been shown throughout and their Latin names have been employed as in Gray's Anatomy.

This work has the advantage of clarity since, with few exceptions, each muscle is shown in a single diagram together with its concise description. It limits the non-essentials without any sacrifice of essentials, since it permits a rapid and accurate survey of skeletal muscular anatomy. The line drawings are excellent. Since the trunk and deeper neck muscles do not lend themselves readily to accurate electrical testing, only the general motor points of the face are shown in a single figure. This work should be particularly valuable to students and physical therapists.

NUTRITION AND DIET THERAPY. A TEXTBOOK OF DIETETICS. By *Fairfax T. Proudfit,* Instructor in Nutrition and Diet Therapy, University of Tennessee College of Medicine; University of Tennessee School of Nursing; Director of Dietary Department, John Gaston Hospital, Memphis, Tennessee; and *Corinne Hogden Robinson,* Formerly Instructor in Nutrition and Diet Therapy, Columbia University School of Nursing; Supervising Ward Dietitian at Presbyterian Hospital, New York City, 1941-1944; Research Assistant in Nutrition and Biochemistry, Children's Research Foundation, Cincinnati, Ohio, 1931-1941. Ninth Edition. Cloth. Pp. 782, with illustrations. Price, $3.75. New York: The Macmillan Company, 1946.

Since 1918, this textbook has been recognized as an authority. To review the ninth edition one needs only point out the revisions and additions as it is too well known to need too much discussion. In the preface it is pointed out that the first section dealing with normal nutrition has been rearranged from the previous edition in that proteins, carbohydrates and fats are discussed before energy metabolism. An important addition to the first section is the chapter on "Safeguarding the Food Supply" in which food poisoning, food preservation and food legislation is discussed. In section II, a new chapter has been added, "Feeding the Aged." All tables have been brought up to date in accordance with the latest data on food values. It cannot be too highly recommended.

THE CHEMICAL COMPOSITION OF FOODS. By *R. A. McCance,* M.D., Ph.D., F.R.C.P.; and *E. M. Widdowson,* B.Sc., Ph.D., From the Department of Medicine, University of Cambridge. Cloth. Pp. 156. Second Edition. Price, 6s. London: Medical Research Council, 1946.

This book consists largely of tables of the analysis in 100 Gm. quantities of the principal foodstuffs. The classification has been made practical rather than scientific. Incidentally, many recipes are given for typical English dishes such as Yorkshire pudding, scones, etc. Because it is made up largely of these specific tables it makes a good reference book for those in need of this material.

PHYSICAL MEDICINE ABSTRACTS

Physical Rehabilitation of the Severely Handicapped. Earl C. Elkins.

J. Kansas M. Soc. 48:57 (Feb.) 1947.

There are many types of conditions related to the central nervous system which may cause severe disability. Of course many patients who have such disability cannot be helped by physical rehabilitation. In this presentation only those types of disabilities that are reasonably common will be considered. Some of these conditions have increased in frequency owing to the war, industrialization and the increase in the number of automobile accidents throughout the nation. Conditions which most commonly produce severe disability, which in the past frequently were not considered amenable to physical rehabilitation are neurologic lesions resulting in paraplegia. These disabilities may result from injury to the spinal cord, benign neoplasms, infection, vascular accidents and degenerative diseases which are not progressive. Many of these patients, in the past, were considered to be permanent and complete invalids. Therefore, no particular treatment was attempted and the patient became totally dependent on his family or on society.

Training and rehabilitation of severely disabled patients requires some special skills. It cannot be relegated to untrained persons. However, common sense, patience, ingenuity and the ability of the physician to put himself mentally in the position of the patient will have much to do with whether the physician continues to have a defeatist attitude with regard to rehabilitation or whether he attempts to help the patient to gain even a small degree of independence.

It should be emphasized that elaborate equipment is not necessary. If the patients who receive training are carefully selected, long periods of hospitalization may not be necessary. With a basic knowledge of muscular function on the part of the physician and with the help of a trained technician, many procedures can be evolved without the necessity of special training in reeducation of muscles and in general exercise.

It also should be pointed out that patients or their families cannot be taught in a few easy lessons how to carry on rehabilitation unless the patients have been partially trained before treatment is attempted at their homes.

Not all patients who are severely disabled are going to be successfully rehabilitated or even partially so. In some cases, complete failure will result; however, if the activity of only a relatively small percentage of these patients is returned to somewhere near normal, the effect will be worth while. Many of the patients need not lead the life of a complete invalid and many can be made less dependent on their families and on society than they would be without training.

Convalescent Care of the Weakened Shoulder With Particular Reference to the Use of the Overhead Sling. Robert L. Bennett.

South. M. J. 40:120 (Feb.) 1947.

From the standpoint of functional capacity, that portion which we designate as the "shoulder" or the "shoulder joint" is one of the most important and certainly the most versatile of the body segments. No other segment has such extensive range, in so many planes of motion. Its extreme mobility is accomplished by a complex coordination of muscle groups acting on four major articulations. Because of the complexity of the interplay between these joints and muscles, a clear picture of the mechanics of motion in this segment is difficult to obtain. The excellent descriptions by Codman and Inman offer the greatest assistance. Most of us have a tendency to think of the "shoulder joint" only as the glenohumeral articulation. This leads to inadequate appreciation of shoulder mechanics and the application of incomplete routines in correcting muscular weakness in any one or all of the shoulder girdle muscles.

Weakness in the muscles of the shoulder girdle result from central and peripheral nerve lesions, as well as from traumatic lesions about the shoulder that result in disuse and limited mobility. Therefore, in consideration of the causes of muscular weakness of the shoulder, we must not think only in terms of acute anterior poliomyelitis, polyneuritis, Erb's palsy, brachial plexus injuries, and other purely motor nerve problems, but also realize that fractures, dislocations, contusions, sprains, bursitis, tendonitis, fibrositis, scalenus anticus syndrome, and other local bony and soft tissue lesions can result in severe weakness.

Deconditioning or Rehabilitation — Which? A. William Reggio.

Am. J. Surg. 73:219 (Feb.) 1947.

On May 30, 1941, at the Annual Meeting of the American Association for the Surgery of Trauma, Dr. Robert H. Kennedy of New York said, "We are wasting a tremendous amount of money and manpower by treating a broken bone and letting a well man get sick physically and mentally while under our care. Then after the damage is done, we spend months, years, or a lifetime trying to bring him back to normal."

In discussing the paper Dr. Frank D. Dickson of Kansas City, Missouri, said, "We . . . have been listening to methods of treatment as far as

the fracture itself is concerned and we are learning of more and more methods all the time. There is, however, great danger that we will become so preoccupied with the actual setting of the fracture and its local treatment that we will forget . . . about the human being with whom we are dealing."

The author in his discussion said: "One trouble is that many of the doctors who want to get their patients back to work do not know how to get them back. They do not know enough about physical therapy or occupational therapy."

Many excellent surgeons have never really seen physical and occupational therapy functioning at their best and as a result do not realize how valuable an adjunct these two can be to their efforts in restoring a casualty to economic usefulness. This is not entirely their fault because there have been many erroneous ideas promulgated regarding the work of both physical and occupational therapists.

Physical therapy is not just a lot of baking and slap dash massage or the turning on of various electric gadgets. It is different from that and an investigation of the methods and modalities employed will prove instructive.

Occupational therapy likewise is not merely the making of belts and leather pocket books. It is a purposeful, functional therapy applied scientifically by trained therapists for the restoration of function.

The blame for not obtaining a good functional result is then placed on the shoulders of physical and occupational therapy instead of where it belongs, on the physician. The age of miracles is not yet past but it is a trifle optimistic to expect them to occur frequently enough so as to cover up inexcusable procrastination.

Industry is well aware of the loss in man-hours and wages as well as the high cost of compensation and is doing much to remedy this. More needs to be done and this Association is in an excellent position to help towards that end. Some remedies are suggested: 1. Start in the medical schools by teaching the basic principles of physical medicine, physical and occupational therapy and rehabilitation. 2. Require surgical internes to serve some time in the physical and occupational therapy departments and acquire a working knowledge of modalities and methods used. 3. Require surgical residents to serve some time in these departments receiving all referees and planning the treatment with the chief therapists, as well as administering therapy. 4. Periodically take up rehabilitation matters at staff conferences and have the staff members occasionally visit the departments while in full swing. 5. Have the chief therapists from the physical and occupational therapy departments make periodic ward rounds with the surgeons and attend staff conferences. 6. Allocate time for papers or discussions on rehabilitation at national, state and local medical society meetings.

A Simple Method of Removing Eyelashes by Electroylsis. Jack S. Guyton.

Am. J. Ophth. **30**:57 (Jan.) 1947.

The root of an eyelash may be destroyed by electrolysis without causing detectable scarring. Novocaine is injected around the offending lash. The principle involved in destroying a lash root in this simple manner is to pass a galvanic current of from 0.2 to 2.0 milliamperes through the patient's body. Since the needle (cathode) inserted into the lash root is very small, a sufficient concentration of hydroxyl ions is generated around the needle tip to destroy the hair follicle.

The Meaning of Normal. John A. Ryle.

Lancet **6436** (Jan. 4) 1947.

In medicine and the medical sciences the word "normal" is in constant use but, as a rule, without a proper clarification of its meaning.

For every organ and tissue, and in respect both of its structure and its function, there is a natural range of variability in any population studied and in the species as a whole. Within this range efficient performance and adaptation to common stresses may be recognized. The "normal," in biology and medicine, is better expressed in terms of this variability than as a hypothetical mean or standard.

The study of human variability within the normal range is important (1) as a fundamental biological study; (2) as supplying necessary standards in medicine for the recognition of health and sickness and borderline states; and (3) because the extremes within the normal range of variability in respect to certain functions may help to explain certain innate resistances and predispositions to disease and to place the study of diathesis on a firmer footing.

The term health ("wholeness"), as affecting the individual, should embrace (besides those of sensory well-being and structural integrity) ideas of balance and adaptability; these in turn reflect the coordinated activity of component parts each functioning within its normal range.

Health and disease know no sharp boundary. They could only do so if it were possible for biology to adopt the dictionary definition of normality. But variability, both in time and in the species, is one of the most distinctive and necessary attributes of life, which thus admits no constant and no norm.

Occupational Therapy. Marguerite E. Bick.

Hospitals **21**:55 (Jan.) 1947.

The occupational therapy program for psychiatric patients is designed to meet their needs on an individual and group basis. Through the relation set up between the worker and the patient, the patient develops skills and outlets which bring satisfaction and increased confidence to the individual. Through the relation set up within the group of patients under the guidance of the worker, the patient is given the opportunity to test, reestablish and build healthy interpersonal relations and social attitudes.

The Physiology of Pain. E. D. Adrian.

Practitioner 158:943 (Jan.) 1947.

All recent evidence has confirmed the view that pain is produced by the stimulation of the fine terminal branches of nerve fibers which end freely without any capsule. But the exclusion of the larger afferent fibers leaves many more of smaller diameter to which it is more difficult to assign specific functions. They can be divided into myelinated fibers ranging from 6 μ in diameter down to 2 or 3 μ, and non-myelinated fibers of 1 μ diameter, or less. The latter conduct very slowly, at 1 meter a second or less, the former at rates varying from 10 to 40 meters a second. Sensations of contact and of temperature are produced by the myelinated group and there is little doubt that fibers of both groups can give rise to pain.

No doubt the same kind of nerve fibers and endings take part in the production of pain from the deeper parts of the body, but unfortunately the pains which are of most interest to medical science are far less accessible to investigation than are pains from the skin. Even for the skin endings one cannot be certain of the precise mechanism of stimulation. It is generally held that the essential change involved in the excitation of a nerve fiber is a sudden increase in the permeability of the surface membrane.

Normally, a nerve fiber can be active without influencing its neighbor, but the insulation is lost if the surface is damaged and it has been suggested that the pain of causalgia may be caused in this way, by the direct interaction of sympathetic with pain fibers at the site of the injury.

So far as deep pains are concerned the adequate stimulus is often the excessive contraction of smooth muscle; in arterial spasm, for instance, or in intestinal colic. What kind of mechanical disturbance this would produce in the afferent endings is not clear, but it should be enough to cause a temporary breakdown of the surface membrane in some part of the terminal sections of the fiber.

The wide ramifications of the individual nerve fibers help to explain how pains can arise from so many deep regions which have a relatively scanty afferent nerve supply. It helps also to explain the poor localization of deep pain or its reference to the surface of the body. To account for this peripheral reference it must be supposed (a) that there is a convergence of pain pathways from the surface and the interior so that some of the ascending fibers in the cord are accessible to both, and (b) that in default of special localizing signs a message which reaches the point of convergence will always be judged to have started from the surface. Both assumptions are reasonable. As regards (a), it is probable that the convergence takes place at the spinal level, since Head and Mackenzie showed that deep pains are referred to the skin of the correspoding spinal segment. It is known that both superficial and deep pain fibers activate spinal neurones which transmit the message by the opposite anterolateral column and some of these neurons may well be shared by both. As regards (b), it is clear that any message from the skin will be relatively well localized: the skin has a rich afferent supply, and it can be seen and touched, so that the brain has built up a detailed reference map of the body surface.

Rheumatoid Spondylitis: Its General Features and Management. Edward W. Boland.

California & West. Med. 65:285 (Dec.) 1946.

Rheumatoid (ankylosing) spondylitis is one of the important causes of chronic back disability in young adult males. Unfortunately rheumatoid spondylitis often remains unrecognized until after marked spinal rigidity ("poker spine") and pronounced calcification of the paraspinal ligaments ("bamboo spine") have occurred; at such a late stage little can be expected from preventive or corrective therapeutic procedures.

Measures designed to improve general health are just as important in the treatment of spondylitis as they are in peripheral rheumatoid arthritis. Such measures should include a high caloric diet with vitamin supplements, iron salts if hypochromic anemia is present and adequately regulated rest. Physical activity requiring undue use of the back should be curtailed routinely. Patients with disease of mild or moderate severity should have at least nine hours of bed rest at night and an additional one or two hours in bed during the day. Complete bed rest is rarely indicated; occasionally it is advised for patients with severe rapidly progressive disease. Acetylsalicylic acid should be given at frequent intervals, if necessary, to control pain. Baking, massage, diathermy and other locally applied physical therapeutic measures may at times be of help in giving symptomatic relief; occasionally they tend to aggravate the symptoms.

Much can be accomplished in preventing postural deformities with relatively simple exercises if these are carried out conscientiously day after day for a period of years. Patients should be made to understand that the supervised exercises performed at the hospital or physician's office are merely instruction periods; when instruction is completed the rest is up to the patient himself. When the disease is early or relatively early, great emphasis should be placed on making the patient posture conscious. He must be taught to assume a proper stance at all times, with the lower abdominal muscles pulled in, the thorax raised, the shoulders squared and the head back. In addition he must be taught trunk stretching exercises (in both the erect and supine positions), hamstring and calf stretching exercises, deep breathing exercises and exercises for the correction of special postural defects; these should be performed twice daily at home. Simple analgesics, such as acetylsalicylic acid, given thirty to forty-five minutes before hand, and/or a hot tub bath often allow such exercises to be accomplished more readily. The spondylitic patient should be instructed also in the use of a firm bed (with boards), without pillow and in the use of a blanket roll for spinal hyperextension. Such measures

should be carried out as preventive therapy even thought postural deviations are minimal or have not yet occurred.

Vocational Rehabilitation for the Tuberculous. E. M. Ashworth.

West Virginia M. J. 43:8 (Jan.) 1947.

During the past year special attention was given to a study of the rehabilitation of the tuberculous in West Virginia with the hope that a sound In-Sanatorium program might be established.

The first steps in setting up the plan were to explain the services and ask for suggestions and recommendations from representatives of the following groups: superintendents of state sanatoria, the state tuberculosis and health association, state health department and the state Board of Control.

Rehabilitation procedures, like other forms of activity, must be prescribed primarily within the physical capacities of the person. This means collaboration on each case by the physician and the rehabilitation counselor. The physician prescribes and the rehabilitation counselor carries out the prescription. The dosage should be controlled through the medium of repeated clinical evaluation of the patient's condition.

Physical Medicine in the Netherlands. J. van Breeman.

Brit. J. Phys. Med. 9:180 (Nov.-Dec.) 1946.

In the physiologic laboratory of the University of Amsterdam much interest is being shown in electrophysiology, especially of the muscles and nerves. The only medical thesis in medicine which has been accepted cum laude in Amsterdam since "time immemorial" dealt with this subject. In the University of Utrecht more interest is being shown in the physical side, especially in the effects of heat; it is in this university that Professor Moll, the well-known authority on bolometry, holds the Chair in Physics.

Finally, in the Netherlands there is a large industrial output of physical therapy apparatus; the scientists employed in the laboratories of these factories have published a number of papers which are of importance to physical medicine. Coordination of activity in these various spheres will evert a beneficial influence and efforts towards obtaining this are being made.

A New Sensitive Portable Plethysmograph. G. E. Burch.

Am. Heart J. 33:48 (Jan.) 1947.

A new portable plethysmograph is described which is all metal and, therefore, sturdy and free from the difficulties of deterioration. A device for standardization is incorporated which makes it possible to correct for finger and toe size, thereby resulting in a completed plethysmogram which can be read directly from subject to subject and from time to time in the same subject. This eliminates calculations usually required to convert volume changes to standard units. The plethysmograph also contains a master elapse time recorder which makes it possible to record time even when the camera is off. By means of a baseline adjuster and recorder, gross or large and slow variations in volume of the part can be recorded.

The completed plethysmogram is discussed and five types of spontaneous deflections in volume are considered. The plethysmogram shows the volume changes at slow and fast speeds. The former makes it possible to study all five types of spontaneous deflections in volume, while the latter makes it possible to study the configurations of the pulse wave in detail.

A discussion of the methods of recording the plethysmogram, precautions and possible errors in recording, and its interpretation are given. The use of plethysmography in the study of peripheral vascular disease, psychogenic states, and states of relaxation and tension are briefly indicated. Detailed applications of the plethysmogram to normal and abnormal clinical states will be presented in the near future.

According to the author this plethysmograph is a new instrument which is objective, precise, simple and practical. It has great promise in the study of many problems in health and disease which manifest themselves by disturbances in the blood vessels, lymphatics and intercellular and intracellular and fluid volumes of the tips of the fingers and toes. By far the greatest number of experimental and clinical applications remain unknown. As with the introduction of any new instrument which has applications in the biologic fields generally and broad use in these fields, the science is in its infancy.

The Effect of Beta-Dimethylaminoethyl-Benzhydryl-Ether-Hydrochloride on the Histamine Threshold of Human Skin. Milton B. Cohen; Harold J. Friedman; Jonathan Zonis; Meade Burke, and Lewis E. Abram.

J. Allergy 18:32 (Jan.) 1947.

During the past year Loew and his associates have reported that beta-dimethylaminoethyl-benzhydryl-ether-hydrochloride is effective against anaphylactic shock in guinea pigs and in preventing fatal "asthma" induced by the inhalation of histamine. This preparation is at least 30 times as effective as theophylline-ethylene diamine as a bronchodilator, and is about twice as effective as N-phenyl-N-ethyl-N′-diethylethylene diamine, the best of the Forneau histamine antagonists. Like the Forneau preparations, this substance diminishes the blood pressure-depressing effect of histamine and, therefore, seems to have an effect on the vascular musculature as well as on that of the bronchi.

The initial or threshold reaction consists of numerous punctate wheals in the area occupied by the positive electrode. The speed of its development depends on the amount of pressure which has been applied through the electrode. In our experience variations in pressure do not affect the end point, but only the speed of development of the wheel.

In carrying out the threshold test the authors use dilutions of histamine representing histamine base in amounts varying from 1:200,000 to 1:6,400,000 and physiologic saline as a control. In work previously reported they showed that in 50 normals tested by this technic the threshold to histamine was 1:6,400,000 in 45 and 1:3,200,000 in five. When, following treatment with any antihistamine substance it requires a dilution of 1:1,600,000 or more to produce the initial wheal, the authors consider the change to be significant.

Secondary Emanatory Phenomena in the Blood of Irradiated Subjects. M. A. Cooke.

Brit. J. Phys. Med. 9:172 (Nov.-Dec.) 1946.

The autotransfusion of blood irradiated with ultraviolet light has been used in the United States in many acute pyogenic infections. The use of this therapy has raised once more the question of secondary emanatory phenomena.

These experiments demonstrate not only that secondary emanations can be detected from blood irradiated artificially, but that they are also given off from the blood of subjects who have received ultraviolet light therapy. The secondary emanations are quite marked after only one week of general irradiation. The emanations persist in the blood for several days, even after a short course of therapy.

Surgical Refrigeration and Preservation of Tissue. Lyman Weeks Crossman, and Frederick M. Allen.

J. A. M. A. 133:377 (Feb. 8) 1947.

Experience to date continues to confirm the safety and benefit of refrigeration anesthesia. Not only is this anesthesia by brief chilling advantageous for orthopedic and reconstructive operations, but also successful healing has been reported in limbs which have been refrigerated for a number of days or weeks. Besides clinching the harmlessness of the low temperature, these observations point the way to new developments in surgery. Recent experiments define some limitations and also extensions of hypothermic treatment. They suggest uses of reduced temperature prophylactically in some operations involving shock and therapeutically, especially for burns.

The Outlook for Physiology. C. Lovatt Evans.

Lancet 6438 (Jan. 18) 1947.

During the last half-century the exact sciences have shown an amazing growth; there is every reason to suppose that their active growth will continue, though perhaps the advances cannot be expected to maintain during the next fifty years the dramatic and revolutionary quality which has marked the progress of these sciences during the first half-century. A feature of the second half of the century that is widely expected to be without any precedent in the history of mankind, however, is the application of the results of research in the pure sciences to the needs of man, and the ultimate fulfillment of the promise of a world of leisure and plenty. Parenthetically, no biologist can be blind, though it is a convention to pretend to be, to the obstacles in the way of a realization of these hopes, the prerequisite changes in the structure of society and even in the nature of man himself, for history shows that the pains of war, like those of labor, are soon forgotten under the compelling force of primal instinct.

Physiology, a science in its own right, and a main pillar in the edifice of scientific medicine, has under gone great changes in the past few decades; it has become vast and complex. It has been largely responsible for the birth of modern biochemistry and is now taking its share in developing biophysics. It has returned to a closer connection with medicine and the phenomena of daily life and there is a need for education of the public in elementary physiology. British physiology has a past of which to be proud, and a future to which to look with confidence. Its present state, in common with that of other sciences, is one of flux and perplexity; with proper material support its own fecundity will ensure that it will go on beyond these difficulties and from strength to strength. Its development cannot be planned or directed. The functional outlook which it represents, by whatever titles it may be called, will long continue to be an integrative influence in medical education and an inspiration to research.

Medical Rehabilitation: The Doctor's Responsibility. Alfred R. Shands.

Delaware State M. J. 19:1 (Jan.) 1947.

In the 18th century Cullen once wrote: "For when many new facts have been acquired, it becomes requisite that these should be incorporated into a system whereby not only particular subjects may be included, but the whole may be rendered more complete, consistant and useful." This is the status of rehabilitation today. The war has been the means of acquiring an enormous volume of new facts on all types of subjects relating to the rehabilitation of the sick and wounded. Now it becomes requisite that this accumulation of new factual data be integrated into a system which will be "complete, consistent and useful" in the work of attaining the goal of rehabilitation, namely, "the restoration of the handicapped to the fullest physical, mental, social, vocational and economic usefulness of which they are capable."

It is the responsibility of the physician to restore the sick and wounded to maximum usefulness in the minimum time. How better can this be done than by adding to our present system of therapy a system of active medical rehabilitation so recently learned during World War II. This must be done, for it shall not be said that physicians are neglecting their duty in failing to apply to medical practice and concepts of the "third phase of medicine."

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ORIGINAL ARTICLES

EDITOR OF THE MONTH

RICHARD KOVACS, M.D.
New York, N. Y.

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PHYSICAL MEDICINE AND REHABILITATION IN THE VETERANS ADMINISTRATION *

DONALD A. COVALT, M.D.

Assistant Medical Director, Medical Rehabilitation and Physical Medicine, Veterans Administration

WASHINGTON, D. C.

It is indeed a great pleasure to have the opportunity of speaking at this annual meeting, and I shall attempt to describe the organization and function of the Medical Rehabilitation and Physical Medicine Service in the Veterans Administration.

General Bradley and Dr. Hawley have one goal, and that is to give the very best medical care possible for the patients in Veterans Administration hospitals. In order to accomplish this, liaison has been established with the American Medical Association and with most of the Grade A medical schools and universities of the country. This program has been so successful that, to date, of the 77 Grade A medical schools throughout the country, every one has signified its willingness to cooperate with the Veterans Administration in order to give the very best medical care to the patients within our hospitals. Fifty-six of these Grade A schools are actively engaged in this program. The twenty-one others are anxious to start their programs but are unable to do so because of the fact that there are no Veterans Administration hospitals near enough for such a scheme to be practical.

Training for residents in all of the specialties is being made available to physicians in the Veterans Administration hospitals that have medical school affiliations. First, a dean's committee is set up, composed of the senior chiefs of service of the medical school. These, in turn, appoint their highest professional talent as senior consultants to the Veterans Administration. Junior consultants, or attending men, are appointed to carry on the actual training program for residents within the hospitals. The attending physicians work up to half a day, and even more in some instances. These men are usually veterans who have had teaching connections with the universities before they left for the services. They make ward rounds, supervise the training of the residents and the actual medical care of the patients. These men supplement the full-time professional staff within the Veterans Administration hospital. The success of this program has been astonishing. Patient days in the hospitals have been reduced; surgical procedures have been increased and with a more rapid turnover of patients. All this helps to relieve the backlog of patients who are waiting for admission into Veterans Administration hospitals.

The second thing accomplished has been the removing of the doctors, dentists and nurses from the Civil Service Commission and placing them under the jurisdiction of the Department of Medicine and Surgery. Along with this, Dr. Hawley immediately decided to establish a Medical Rehabilitation Service for the Veterans Administration. With the giving of the very best of medical care, he felt that it was necessary to carry the man on through, not alone until he leaves the hospital but until he is back at work again.

I should like to begin the description of the organization by naming the National Consultants in the program. Dr. Frank H. Krusen has been appointed as Chief Consultant in Physical Medicine to the entire Veterans Ad-

* Read at the Twenty-Fourth Annual Session of the American Congress of Physical Medicine, New York, Sept. 4, 1946.

ministration. Dr. Howard A. Rusk has been appointed as Chief Consultant in Medical Rehabilitation and Dr. George G. Deaver as Associate Consultant in Medical Rehabilitation. A Consultant has been appointed for each of the thirteen branch offices, and, in each instance, a man prominent in the field of Physical Medicine and Rehabilitation, has been chosen. They are:

Branch Area 1.—Dr. Arthur L. Watkins
Branch Area 2.—Dr. Richard Kovacs
Branch Area 3.—Dr. George M. Piersol
Associate: Dr. Carl Levenson
Branch Area 4.—Dr. George D. Wilson
Branch Area 5.—Dr Robert L. Bennett
Branch Area 6.—Dr. Walter J. Zeiter
Branch Area 7.—Dr. John S. Coulter
Branch Area 8.—Dr. Miland E. Knapp.
Branch Area 9.—Dr. Frank H. Ewerhardt
Associate: Dr. Gordon Martin
Branch Area 10.—Dr. Ben Boynton
Branch Area 11.—Dr. Arthur Jones
Branch Area 12.—Dr. O. Leonard Huddleston
Branch Area 13.—Dr. Harold Dinken

In addition to the foregoing, many of the Veterans Administration hospitals have their own consultants in physical medicine. The program cannot fail with these men as consultants!

There has been in operation in the Veterans Administration a program of Physical Medicine for many years, practically since World War I, which consisted of Physical Therapy and Occupational Therapy. Dr. Hawley felt, however, that these two divisions did not provide a complete rehabilitation program sufficient in scope for the thousands of sick, injured and disabled veterans who needed other types of therapeutic treatment. Consequently, on May 18, 1946, after careful laying of the ground work, Veterans Administration Circular No. 121 was published, establishing a Medical Rehabilitation Service in all Veterans Administration hospitals, consisting of the following component units:

1. Physical Medicine, subdivided into: Physical Therapy, Corrective Physical Rehabilitation, Occupational Therapy, Educational Retraining, and Prevocational Shop Retraining
2. Industrial Therapy
3. Aural Rehabilitation
4. Rehabilitation of the Blind

Under Physical Medicine, the existing departments in this specialized field have been expanded, new modern equipment has been added and highly qualified personnel, who had had invaluable experience in the Army and Navy in World War II, are being recruited to supplement existing medical and auxiliary staffs. No hospital can be considered modern and capable of rendering the best services to veterans without a well organized and well equipped Physical Therapy Department—the Veterans Administration has been fully cognizant of this fact. It still feels the necessity of having enough trained personnel to administer treatment and to direct the employment of the various physical procedures, and it is repeatedly emphasizing this principle. The Physical Therapy Department functions directly under the medical supervision of the Physiatrist. All forms of physical therapy are administered by trained therapists in accordance with medical prescriptions for the individual patient. I should like to mention at this point that professional rating in Civil Service has been obtained for qualified physical therapists.

Physical Therapy Departments are now in operation in all Veterans Administration hospitals and are, or will be, fully equipped to provide bedside and clinic administration of the various physical modalities. These departments function independently under the direction of the Chief of Physical

Medicine, whose status is on the same level as that of the chiefs of the other hospital services. Patients are referred from other services in the hospital and from outpatient clinics.

A new division of Corrective Physical Rehabilitation has been organized, and in each General Medical and Surgical and Neuropsychiatric hospital a Chief of Corrective Physical Rehabilitation will render prescribed individual exercise to patients for the purpose of speeding recovery, preventing atrophy of normal muscles and preventing deconditioning while a patient is hospitalized. The Chief of this department is, in turn, responsible to the physiatrist. Personnel in Corrective Physical Rehabilitation have been especially selected on the basis of their training and experience during World War II in reconditioning battle casualties.

In all hospitals, Departments of Occupational Therapy have been established and expanded to integrate occupational therapy with the total treatment program, so that all possible advantage may be taken in reestablishing the best functional use and increase in muscle strength of injured and diseased extremities, amputation stumps and spinal cord injuries. It is fully realized that occupational therapy activities are essential in any rehabilitation program, and this principle has been interpreted to mean that occupational therapy will include any occupation, medical or physical, which is prescribed and directed to enhance recovery from disease or injury and given for the further purpose of promoting a satisfactory adjustment of the patient. In the Veterans Administration hospitals, occupational therapy is considered as an individually prescribed treatment which should be coordinated and correlated with all other forms of therapy, so that the final results will be for the maximum therapeutic benefit of the veteran. Occupational therapy must be prescribed by the physiatrist in charge of the veteran. Simultaneously with the medical benefits, the long-range rehabilitation objective is guided as soon as possible to the chosen vocational goal for the individual veteran.

The Educational Retraining Division was organized as a necessary adjunct in the treatment of the "whole man" and as a motivating factor in his recovery. It is of great interest that 65 per cent of the enlisted men and 13.5 per cent of the officers of the services in the last war did not graduate from high school before entering the Army or Navy. There are over 175 United States Armed Forces Institute courses now available to hospitalized veterans so that they may complete their high school curriculum, or take a course of special interest or benefit to them by either the self-study or the correspondence method. There are also other courses offered to orient the veteran in his chosen field in the event that he desires to open his own shop. All these courses are given at no cost to the veteran himself. The Chief of Educational Retraining in the hospital supervises this program at the hospital level. The educational program offers courses of three general types: (1) technical subjects, such as automotive repair, electricity and radio; (2) academic subjects, such as English, foreign languages, and social studies; (3) business subjects, such as typewriting, bookkeeping, and business management.

Another phase of the educational program is close cooperation with local universities, colleges and high schools, which can be of tremendous assistance in educating our hospitalized veterans.

The Prevocational Shop Retraining Program has been created as a new therapeutic supplement to the Rehabilitation program for training in various fields according to the veteran's ability and personal choice. In this way, the veteran utilizes to excellent personal advantage every hour of hospitalization and at the time of discharge from the hospital this training is further

continued under the supervision of the Vocational Rehabilitation and Education Service until the veteran is ready for employment. The Chief of Prevocational Shop Retraining supervises this program in every hospital. This program will be an intensive one, and it comprises purely prevocational training, thus leading to a continuous process of rehabilitation. Rehabilitation must be a continuous program and an individualized one. Any lag time loses people from the program forever. Thus, through the GI Bill of Rights, or Public Law 16, the veteran may immediately be placed in "on-the-job training" or be enrolled with a university for more advanced instruction at the time of his discharge from the hospital.

The Industrial Therapy Division will be organized in those hospitals which are advantageously situated in or near an industrial center, so that the objective of actual industrial work may be accomplished. The adjunct toward the total treatment regimen may be carried on in the ward and even at the bedside, and it has been found to motivate the patient for earlier discharge from the hospital and subsequent independence in his community.

The patients with spinal cord injuries resulting from World War II are another particular problem in rehabilitation. To meet this challenge adequately, spinal cord injury centers have been established for the highly specialized rehabilitation of all veterans who have a paralysis of the lower half of the body due to a severe injury of the spinal cord. These centers are completely organized and functioning at the present time at the hospitals at Richmond, Va.; Memphis, Tenn.; Hines, Ill.; Van Nuys, Calif.; Aspinwall, Pa., and Bronx, N. Y. There are about 2,400 veterans with this disability, and their eventual rehabilitation constitutes a tremendous medical and social problem.

Teams of Veterans Administration personnel have been trained for the rehabilitation of severely disabled veterans at the Institute for the Crippled and Disabled in New York city, where courses were given under the medical direction of Dr. George G. Deaver. As a result of this training, the personnel assigned for these courses are now carrying out the rehabilitation technics which were used so successfully in the Army, and they constitute teams for the more efficient administration of this work in the veterans hospitals. Medical Rehabilitation Boards are now functioning in each hospital where personnel have been trained in these technics.

In collaboration with the National Tuberculosis Association of New York city, four rehabilitation seminars have been held for Veterans Administration personnel to study the rehabilitation procedures necessary for the complete recovery and readjustment of the veteran with pulmonary tuberculosis. These seminars were conducted at the Veterans Administration hospitals at Oteen, N. C.; Sunmount, N. Y.; Tucson, Ariz., and Wood, Wis. Approximately 300 Veterans Administration personnel attended these seminars, and now they are capable of working as teams for the rehabilitation of our tuberculous veterans.

The underlying theme for the successful application of all rehabilitation procedures consists in supplying definite motivation principles, of integrating these principles into a regimen of therapy which emphasizes that the "whole man" must be treated, not merely his disability; further, that all rehabilitation procedures must begin early, that each step in the program must be progressive and that all phases of the schedule must be purposeful. All treatment must be personalized and individualized so that the veteran may receive the proper incentive for recovery, just as all possible methods were used to motivate him in battle.

In the field of research, two survey projects have been completed. The first one was a study of the number of blind veterans in Veterans Admin-

istration hospitals. This information was necessary in order to determine the most strategic locations for blind centers, where medical rehabilitation could be initiated. The second survey was made to ascertain the total number and types of spinal cord injuries among World War II veterans. These results were used to guide the establishment of rehabilitation programs necessary for veterans with spinal cord injuries. At the present time, there is being organized a plan to make possible special exercises for patients who are to have thoracic surgery. These exercises are designed to prevent and correct the development of scoliosis and shoulder girdle defects so often found following thoracic surgical procedures. The aim of this form of physical exercise will be accomplished by individual preoperative and postoperative training of all such patients. To further supplement the Rehabilitation Program, schools are being organized for the orientation and indoctrination of Veterans Administration rehabilitation personnel in the many phases of this field. One school, opened in the fall of 1946 at Hines-Vaughan, is intended for physical therapists who are going to work with both tuberculous and nontuberculous patients who have had operations on chest. This work is in charge of Mrs. Florence Linduff, who carried out such excellent work in this field for Dr. Hawley in England.

A second school was started on Oct. 1, 1946 for corrective physical rehabilitation personnel. This school was held at the Veterans Administration hospital at Topeka, Kans., under the direction of Dr. Karl A. Menninger. It ran for a period of four weeks, and men with physical education degrees were indoctrinated into psychiatry. After this indoctrination, these men are now giving treatments to patients in Veterans Administration neuropsychiatric hospitals.

Physical Medicine activities have proved an important and necessary adjunct in the Medical Rehabilitation Program for veterans suffering from diseases and injuries of all types. During this postwar period, the problem of Medical Rehabilitation is a tremendous one, but with the knowledge and experience of newer and more effective procedures, and with the benefits of highly efficient apparatus and experienced personnel in this specialized field, this service is making progressive headway in the Veterans Administration.

The Baruch Sub-Committee on Rehabilitation has pointed out that physical rehabilitation fills the gap between the end point of definitive medical care and the real necessity of many patients to return to productive work; therefore, it is necessary to give more attention to each scientific detail of Medical Rehabilitation in order to fill this gap in medical care. It is really the third phase of medicine and can truly be said to be constructive medicine.

In order to complete the establishment of this program, more physicians trained and experienced in physical medicine are urgently needed. To date, sixty-six Chiefs of Physical Medicine have been assigned full-time duty in the hospitals and regional offices. Any physician interested in entering the program should contact the Branch Medical Director of the territory in which he desires his appointment or address his inquiry to the Central Office in Washington, D. C., and my colleagues and I shall be glad to render all possible assistance in effecting his appointment. A recent survey revealed that there are at present sixty-five Medical Rehabilitation Programs in operation at the hospital level, and forty-three more are in the process of completing their organization.

Dr. Krusen once stated: "Not only the science but the art of Physical Medicine and Medical Rehabilitation is developing rapidly and along sound lines." I am happy to be able to say that I think this statement is especially true of the Veterans Administration. The ultimate goal is to have a smoothly

functioning and effective Medical Rehabilitation Program in each of the 114 hospitals and such additional hospitals as may be acquired or constructed. Then not only will it be certain that every veteran will have the finest medical care available for him but it will also be known that every veteran is being restored to the highest possible state of mental and physical condition. In this manner, the greatest possible percentage of these men will return to their homes to live, to work and to produce for themselves, their community and their country.

Discussion of Papers of Dr. Louis B. Newman,* Dr. Donald A. Covalt, and Lieut. Col. Benjamin A. Strickland, Jr., (MC), U. S. A.*

Dr. Fred B. Moor (Los Angeles): The coordinated physical, mental, social, vocational and economic restoration of the handicapped, known as rehabilitation, is a relatively new concept, born largely of the exigencies of war.

As we have learned from the three comprehensive and instructive papers presented, the job is one requiring cooperative team work between medicine and a variety of special fields more or less closely related to it. The medical departments of the armed services and the Veterans Administration have done much in the development of the program of rehabilitation. They have had the problem to cope with on a large scale and have handled it well. Those who saw the Exhibit on Physical Medicine at the recent convention of the American Medical Association must have been especially impressed by the results demonstrated in the rehabilitation of amputees and cord injury cases from the veterans' hospitals.

I am sure we are all grateful to Colonel Strickland for his lucid presentation of the present status of physical medicine in the Medical Department of the Army as well as the plan for continued future development in which clinical research is to play a major role.

It is indeed encouraging to learn from Dr. Newman that no effort is being spared in the endeavor to restore to the maximum, a most disheartening group of cases, the spinal cord injuries. This discussant was impressed by this statement in the summary of his paper, "The hopelessness of the patient with a spinal cord injury of World War I has vanished."

The complete rehabilitation service of the Veterans Administration, as described by Dr. Covalt, for the treatment of the whole man, should be a model for civilian rehabilitation.

A few days before I left California for this meeting, a 22 year old blind veteran came to my office to inquire about the physical therapy course. While serving in the Marine Corps he had been blinded by concussion in one of the Pacific islands. His reason for desiring to take the course was that he might be able to help others, because, as he said it made him "feel good inside." If this is a fair sample of the morale building accomplished in the rehabilitation programs of the armed services and the Veterans Administration, they have been doing an excellent job.

Some large industrial concerns, recognizing their "moral obligation and the social desirability of providing jobs for veterans," are taking up the rehabilitation program where the veterans' services leave off, and, by means of job analysis and by careful study of each individual veteran's capabilities, are placing these men in suitable work. The ultimate result should be highly satisfactory.

Dr. Arthur C. Jones (Portland, Oregon): The rehabilitation of the paraplegic as outlined by Dr. Newman certainly is the epitome of all rehabilitation. I want to emphasize a point or two in passing, one of which is early participation of the patient in the program. This is an important key point which Dr. Newman made with regard to rehabilitation.

Motivation, after all, is a profound element. It is in its basis, emotional. It comes, as you might say, from the areas of the midbrain and no mere sales talk will suffice to encourage this much discouraged human being who has had an injury of the spinal cord.

Examples are of prime importance in showing a paraplegic what can be accomplished, hence the most convincing proof is the success of others in a similar plight. Prevocational shop experience may be the key factor in the recovery of a patient with paraplegia, a combination of exercise with the vision of partial or complete independence. The initiation of the prevocational shop experience in the early stage in the man's hospitalization is another important point which Dr. Newman made.

Col. Strickland, in talking about the contribution of the Medical Department of the Army in the progress of physical medicine, certainly has covered well the manner of that contribution, which has been an outstanding advance. None, I am sure are more gratified in this than the members of the Congress, especially those who have fostered physical therapy in the years when it had, perhaps, a less honored place in American medicine than it is assuming today.

The prospects of continued growth of physical medicine are greater because of the far-seeing plans of those who are guiding this work in the Army and Veterans Administration. I would urge establishment of a board status for physical medicine as soon as possible. It is of prime importance to the continuation of interest

* Papers of Dr. Newman and Lt. Col. Strickland appeared respectively in the February and April, 1947 issues of the ARCHIVES.

in rehabilitation both for soldieres and civilians. It is for those of us who are identified with physical medicine to merit the board status by continued effort.

Dr. Covalt has given us a vision of truly constructive medicine. If enthusiasm and hard work will establishe sound service in physical medicine in hospitals of the Veterans Administration, certainly Dr. Covalt will go a long way in that direction. A dynamic factor is being introduced into the Veterans Administration through this program. It will give means and personnel with which to accomplish rehabilitaion, which is the goal of all medicine and surgery. We use the term "rehabilitation" in thinking of certain categories of patients. I think it is a mistake. The idea is that rehabilitation is the heart and soul of medicine. Success in rehabilitation depends on the understanding and cooperation of the staff surgeons and physicians of the veterans hospitals. They must be persuaded that rehabilitation is part and parcel of their own effort. All medicine will benefit if the profession can be convinced of this truth.

As Dr. Moor has well said, the physician is coming to appreciate how much workers in related fields can do to aid in the recovery of the injured persons for whose welfare the physician is initially responsible.

The problems of civilians which have been merely touched on by the three speakers in related fields can do to aid in the complishment. Those who are identified with civilian institutions will appreciate the difficulty of accomplishment of effective civilian rehabilitation. Certainly rehabilitation is team work between the physician and the patient. The success of rehabilitation in all institutions is going to be in proportion to our understanding of the ideal of cooperation. The success of our effort will be a new success for the art and science of medicine, a humanitarian accomplishment worth all of the work and patience which it entails.

THE EFFECTS OF DIATHERMY ON TISSUES CONTIGUOUS TO IMPLANTED SURGICAL METALS*

H. S. ETTER, COMMANDER (MC), U. S. N.

R. H. PUDENZ, LIEUTENANT MC(S), U. S. N. R.

and

I. GERSH, LIEUTENANT H(S), U. S. N. R.

BETHESDA, MD.

The potential danger of short wave diathermy in patients with metals embedded in their tissues has been a subject of much discussion by physiatrists. The danger allegedly arises from the possibility that the diathermy, even in therapeutic dosage, might either heat the metals to temperature sufficiently high to injure contiguous tissues or distort and concentrate the field immediately surrounding the metal. The importance of the problem has increased considerably since the onset of the war. In addition to the enormous number of patients with retained shrapnel and other missile fragments, an increasing number of casualties are being treated by permanent or temporary implantation of metals in tissue. Undoubtedly the most serious consequence of diathermy would be the destruction of important peripheral nerves which, because of wrapping in tantalum foil or contiguity to bone plates and screws, would make these structures particularly vulnerable. Destruction of skin, bone and muscle is similarly possible. Although diathermy is not commonly administered over the brain, its use in the treatment of sinus infections and cerebral vascular disorders might expose metal skull plates to the short wave field.

* From the United States Naval Hospital and the Naval Medical Research Institute, National Naval Medical Center.

* The opinions expressed in this article are those of the authors and should not be construed as representing the opinions and policies of the Navy Department.

It is of obvious importance to determine experimentally whether or not diathermic injury due to implanted metals takes place. Such experiments were suggested by the Bureau of Medicine and Surgery.[1] A preliminary report on these experiments has been submitted,[2] but the conclusions drawn were based on very few experiments and it was realized at the time that more extensive studies were indicated. It is to be noted that the conclusions of the preliminary report and those of the present report differ somewhat. This is explained by the sparsity of the experimental work in the first report and by the far greater success in the present investigatons in simulating the therapeutic dosage used in patients and avoiding overdosage.

In approaching the problem experimentally, the chief difficulty encountered was devising a satisfactory method for the measurement of tissue temperature during the passage of the short wave radiation. Thermocouple wires and mercury thermometers[3] distort the short wave radiation field and therefore may not give a true index of tissue temperature. The usual method of recording tissue temperature has been to insert the thermocouple lead in the tissue through a needle or cannula before and after the passage of the short wave current.[4] In our earlier work we found this method to be inexact because of the immediate and rapid fall in temperature when the current is turned off. Because of this shortcoming we have used nonmetallic thermometers for tissue temperature recording. To our knowledge this technic has not been described previously, although Schultze-Rhonhof and Rech[5] described the use of alcohol-filled thermometers to measure temperatures in the bladder, vagina and rectum during the passage of short wave currents.

Another difficulty encountered was the inability to know the amount of short wave radiation necessary to heat the tissues to any given temperature. This is a variable well recognized among physiatrists who use a comfortable sensation of warmth as their guide in the treatment of patients. Since the power indicator on the apparatus is not a reliable index of tissue heating, the necessary amount of short wave energy was determined by a method of trial and error in repeated experiments. The principal guide was the presence or absence of burning and the extent of the burning as seen grossly and in the histologic sections through the affected regions. Most of the results were based on material that did not show superficial burns.

Other workers have also been investigating the effects of short wave radiation on implanted metals. Lion[6] has conducted experiments on models in which tantalum has been placed in electrolytes in polystyrene containers in egg albumin solutions or in ground meat. He has found that when these models were exposed to diathermy the heat was not generated in the metal itself but in the medium adjacent to the metal. The tendency toward accumulation of heat was less the more deeply the metal was embedded. He concluded that the danger of damaging tissues containing metallic particles may be a real one. However, these impressions are not borne out in the animal experiments of Peet, and co-workers[7] and Braden.[8] Peet and his colleagues have applied diathermy in therapeutic dosages for twenty-minute periods to rabbits with tantalum plates buried in the sacroiliac muscles..

1. Memorandum from Bureau of Medicine and Surgery, BUMED-X-III-FHM, dated July 5, 1944.
2. Pudenz, R. H.; Gersh, I., and Etter, H. S.: The Effect of Diathermy on Tissues in Which Tantalum Is Implanted: Preliminary data, Research Project X-133, Naval Medical Research Institute and United States Naval Hospital, June 6, 1944.
3. Hemingway, A., and Stenstrom, K. W.: Physical Characteristics of Short Wave Diathermy, Handbook of Physical Therapy, ed. 3, Chicago, American Medical Association, 1939, pp. 214-229.
4. Coulter, J. S., and Carter, H. A.: Heating of Human Tissues by Short Wave Diathermy, J. A M. A. 106:2063-2066, 1936.
5. Schultze-Rhonhof, F., and Rech, W.: Untersuchungen über die tiefere Warmung des menschlichen Organismus im Kurzwellenfeld, Arch. f. Gynäk. 157:468-471, 1934.
6. Lion, K. S.: Personal communication to the authors.
7. Peet, M. M.: Personal communication to the authors.
8. Braden, S.: Personal communication to the authors.

They found an average rise of 2.8 degrees (F.) as measured by a thermocouple. Almost identical temperatures were obtained in the control animals under similar conditions. Braden and his associates are likewise studying the problem in experimental animals. Thus far their gross and histologic observations of tissues contiguous to implanted tantalum have disclosed no destructive effect attributable to diathermy.

Tissue Temperature Measurements

Operative Procedure. — Dogs were used in all of the studies except in one instance (cat). Anesthesia was induced by intravenous injections of pentobarbital sodium (32 mg. per kilogram). Sterile precautions were not observed. All of the metals were implanted under direct vision in one of the hindlimbs. The opposite limb was used as a control. Intramuscular implants were inserted through a muscle-splitting incision and were placed deeply in the tissues overlying the sciatic nerve and the femur. Subcutaneous implantations were made in pouches formed by blunt dissection lateral to the incision. This was done to avoid placing the metal directly beneath the wound. The latter was closed in layers with continuous cotton sutures. The epineurial implants consisted of tantalum and silver foil wrapped around the sciatic nerves. The metals used, their dimensions and the areas of implantation are outlined in table 1.

Application of Short Wave Diathermy. — The short wave diathermy was applied in this series by two machines, arbitrarily designated as A and B. Machine A oscillates at either an 8 or a 24 meter wavelength, varying according to the method of application used. The output circuit is inductively coupled to the oscillator and is tuned to resonance by a variable condenser on the load side. Consequently, the oscillator frequency remains constant and the load is tuned to match it. With this unit the method of application was either with space plates, with an inductance cable or with a curved drum electrode. The 8 meter wavelength was used with the space plates and the 24 meter wavelength with the inductance cable and curved drum. The space plates used were 5 inches in diameter and applied in a plane as nearly parallel as possible to the posterior surface of the animal's thigh and about 1 inch from the skin (fig. 1). One

TABLE 1. — *Dimensions and Sites of Implants Used.*

Metal	Abbreviations	Dimensions (Mm.)	Where Implanted
Tantalum plate, large	LTP	25×25×0.45	Subcutaneous intramuscular
Tantalum plate, small	STP	20×10×0.4	Subcutaneous intramuscular
Tantalum foil	TF	26×20×0.018	Epineurial subcutaneous*
Tantalum wire	TW	200×0.65	Subcutaneous*
Silver plate	SP	20×10×0.4	Intramuscular
Silver foil	SF	45×16×0.07	Subcutaneous* epineurial
Stainless steel (No. 7 Lane Bone Plate)	SS	55×1.6 (width variable)	Intramuscular

* Wrapped around bulb of thermometer.

plate was always centered over the implanted metal and the opposite one similarly located over the control limb. With the inductance cable, three turns of the cable were wrapped around each thigh with approximately 1 inch of toweling beneath for spacing. The curved drum was 16 inches long and 7 inches wide and consisted of a prefabricated coil contained in a closed bakelite compartment. This was readily adjustable to the desired concavity and was symmetrically applied over the posterior surfaces of both thighs, about 1 inch from the skin surface of each thigh.

Machine B employs the principle of a fundamentally resonant load circuit, to which is coupled an oscillator which supplies the variable frequencies demanded by different electrode capacities involving varying amounts of tissue. By oscillating over the range of approximately 9 to 19 meters, the unit can be tuned to match a given load frequency. In addition, it has been claimed that this unit would not heat embedded metals in contrast to the generally held opinion regarding the use of most contemporary equipment producing high frequency fields. With this machine all applications

were made with flexible pads. These pads are cotton-covered, silver-plated electrodes, 6 by 8 inches, with felted cotton spacers placed between the electrode and the electrode cover. One pad was always centered directly over the implanted metal and the opposite one similarly located over the control limb. No spacing other than that contained in the pad was used.

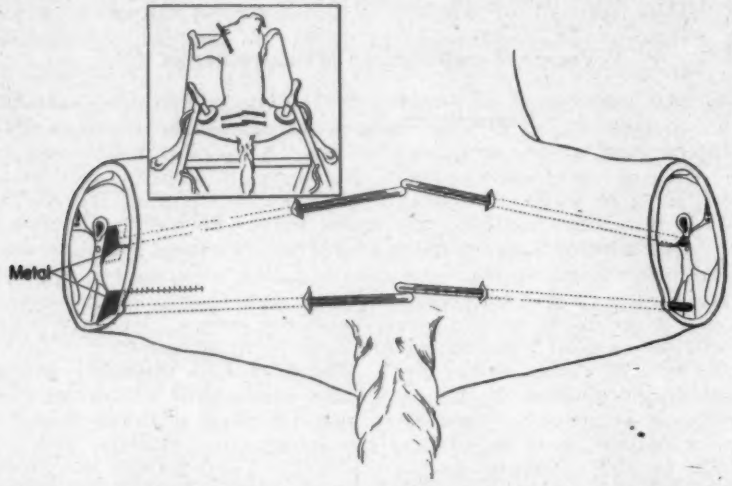

Fig. 1. — Experimental procedure for recording superficial and deep tissue temperatures on the metal and the control sides with nonmetallic thermometers.

At all times care was exercised to avoid contact between the electrode and the stem of the thermometer. All applications were from twenty to forty minutes in duration.

As previously noted, the amount of diathermy administered was determined by a method of trial and error. Because of the size of the experimental animals, the usual amount administered to human patients had to be proportionately reduced. An attempt was made to administer enough diathermy to cause an appreciable rise in the deep tissue temperature and yet remain within a range of temperatures that would not be destructive to the tissues. The usual range of meter readings on each machine as used therapeutically may be compared with the meter readings used in this series (table 2). In every instance, the maximal meter readings quoted for the experimental series produced extensive burns on both metal and control sides. Inasmuch as the output of each machine is different and the power absorption of each subject at each application varies, the only valid comparison possible is from the rise in tissue temperature (tables 3 to 7).

Thermometry. — Temperatures of the tissues contiguous to the metals and of the corresponding area of the opposite limb were measured with nonmetallic thermometers calibrated from —100 to +50 C. with a maximal error of ±0.5 C. To measure the tissue temperature, the bulb of the thermometer was placed either next to the metal insert or, in some instances when strips of metal were used, at the end of the strips. The stem of the thermometer was brought out through a separate stab wound made proximal to the incision used to implant the metal. These stab wounds were made in positions to permit insertion of the thermometers to a depth sufficient to render the stem correction factor negligible.

In the majority of the experiments the same animal was subjected to two applications of short wave diathermy. In a few instances three, and in 1 case, four applications were made on the same animals. In all the experiments tissue temperatures were permitted to stabilize at a low level before each successive trial.

Results of Tissue Temperature Measurements. — The results are outlined in detail in tables 3 to 7. It is noted that the temperature rise during exposure to diathermy tended to be slightly higher in the tissues containing the metal. The M/C factor is determined by dividing the temperature rise on the metal side (M) by the corresponding rise on the control side (C).

This tendency of the metal side to be warmer than the control side may be due, to some extent, to mechanical interference with the circulation caused

TABLE 2. — *Maximal and Minimal Ranges of Diathermy (in Milliamperes) with Machines A and B as Used Therapeutically in Human Subjects and in These Experiments.*

Machine	Meter Reading Therapeutically	Meter Reading in This Series
A	10-15 (190-215 ma)	3-18 (147-230 ma)
B	800-1,500 ma	600-1,500 ma

TABLE 3. — *Temperatures of Tissues Contiguous to Tantalum Embedded in Muscle.*

No.	Weight (Kg.)	Material	Machine	Application	Power (Ma)	Duration (Min.)	Trial	—Metal— Initial Temp. °C.	—Metal— Rise °C.	—Control— Initial Temp. °C.	—Control— Rise °C.	$\frac{M^*}{C}$
1	19.5	LTP	B	Pads	800	30	1	37.0	0.8	37.0	0.8	1.0
2	19.5	LTP	B	Pads	1,200	20	2	37.0	1.3	37.0	1.1	1.18
3	17.5	LTP	B	Pads	1,200	20	2	38.6	2.9	38.7	2.5	1.16
4	4.5	STP	B	Pads	600	30	1	35.0	2.8	35.4	3.1	0.9
5	4.5	STP	B	Pads	800	30	3	36.8	4.0	37.0	4.2	0.95
6	35.0	LTP	B	Pads	1,200-1,500	40	2	37.8	1.8	37.4	1.6	1.13
7	19.5	LTP	A	Sp. pl.	190	20	3	37.6	2.6	37.4	1.8	1.44
8	19.5	LTP	A	Sp. pl.	230	20	4	38.0	3.9	37.9	2.2	1.77
9	17.5	LTP	A	Sp. pl.	180	20	1	38.0	2.0	37.8	2.0	1.0
10	4.5	STP	A	Sp. pl.	163	8	2	35.2	7.8	36.0	5.6	1.39
11	35.0	LTP	A	Sp. pl.	190	30	1	36.5	4.0	36.5	3.3	1.21
						Average			3.08		2.56	1.2

$*\frac{M}{C}$ = Rise °C. metal side / Rise °C. control side

LTP — large tantalum plate; STP — small tantalum plate; Sp. pl. — space plate electrodes.

TABLE 4. — *Temperatures of Tissues Contiguous to Intramuscular Silver and Stainless Steel.*

No.	Weight (Kg.)	Material	Machine	Application	Power (Ma)	Duration (Min.)	Trial	—Metal— Initial Temp. °C.	—Metal— Rise °C.	—Control— Initial Temp. °C.	—Control— Rise °C.	$\frac{M^*}{C}$
1	3.8	SP	B	Pads	800	30	1	35.2	4.0	33.9	4.1	1.0
2	3.8	SP	A	C. drum	163	30	2	35.2	1.2	34.1	3.7	0.32
3	3.8	SP	A	Sp. pl.	148	30	3	35.2	9.0	34.8	11.7	0.77
						Average			4.7		6.5	0.70
1	4.6	SS	B	Pads	1,000	30	1	35.0	4.3	34.9	3.5	1.23
2	4.6	SS	B	Pads	1,000	30	2	35.8	5.0	35.8	3.3	1.51
3	15.6	SS	B	Pads	800	30	1	34.9	4.9	35.2	4.6	1.07
4	4.6	SS	A	Sp. pl.	163	30	3	36.0	12.0	35.5	10.5	1.14
5	15.6	SS	A	Sp. pl.	215	21	3	37.6	8.9	37.8	5.7	1.56
						Average			7.0		5.5	1.30

$*\frac{M}{C}$ = Rise °C. metal side / Rise °C. control side

SP — silver plate; SS — stainless steel plate; C drum — curved drum electrode; Sp. pl — space plate electrodes.

by the metal or to a certain amount of heat storage. Unimpeded circulation in the control limb provided continuous dissipation of the heat developed.

When diathermy was administered to animals under the experimental conditions shown in figure 1 — that is, with a metal plate placed both subcutaneously and intramuscularly on one side with the opposite limb acting as the control — the initial subcutaneous temperatures were generally lower than the intramuscular temperatures. However, during the application of diathermy the subcutaneous temperatures rose quickly and within a few minutes exceeded the intramuscular temperatures. This is shown in the characteristic temperature curves of figure 2. Finally, after cessation of the

TABLE 5. — *Temperatures of Tissues Contiguous to Subcutaneous Tantalum and Silver.*

								—Metal—		—Control—		
No.	Weight (Kg.)	Material	Machine	Application	Power (Ma)	Duration (Min.)	Trial	Initial Temp. °C.	Rise °C.	Initial Temp. °C.	Rise °C.	$\frac{M^*}{C}$
1	17.5	LTP	B	Pads	1,200	20	2	36.8	5.4	36.8	5.1	1.06
2	17.5	LTP	A	Sp. pl.	180	20	1	36.8	2.4	36.0	2.3	1.0
3	10.2	TF	B	Pads	800	30	1	35.0	4.4	34.7	5.3	0.83
4	10.2	TF	A	Sp. pl.	163	30	2	35.6	7.2	36.0	6.5	1.1
5	15.6	TW	B	Pads	800	30	1	34.2	4.0	34.0	4.8	0.83
6	35.0	TW	B	Pads	1,200-1,500	40	2	36.8	2.2	36.8	2.7	0.81
7	15.6	TW	A	Sp. pl.	215	20	3	37.2	5.3	38.0	4.2	1.26
8	35.0	TW	A	Sp. pl.	190	30	1	35.2	5.0	35.5	4.5	1.1
						Average			4.5		4.4	1.00
1	19.0	SF	B	Pads	1,200	30	2	36.8	3.4	36.8	3.2	1.0
2	31.0	SF	B	Pads	1,500	30	1	33.0	6.2	35.5	3.4	1.82
3	19.0	SF	A	Sp. pl.	163	30	1	35.3	5.7	34.2	5.9	0.97
4	19.0	SF	A	Coil	163	30	3	36.8	4.7	36.0	3.4	1.38
5	31.0	SF	A	Coil	163-215	42	2	36.1	4.9	36.2	3.8	1.29
						Average			5.0		4.3	1.28

$\frac{M^*}{C} = \frac{\text{Rise °C. metal side}}{\text{Rise °C. control side}}$

LTP — large tantalum plate; TF — tantalum foil; TW — tantalum wire; Sp. pl. — space plate electrodes.

TABLE 6. — *Temperatures of Tissue Contiguous to Epineurial Tantalum and Silver.*

								—Metal—		—Control—		
No.	Weight (Kg.)	Material	Machine	Application	Power (Ma)	Duration (Min.)	Trial	Initial Temp. °C.	Rise °C.	Initial Temp. °C.	Rise °C.	$\frac{M^*}{C}$
1	10.2	TF	B	Pads	800	30	1	35.3	2.5	35.0	3.5	0.71
2	10.2	TF	A	Sp. pl.	163	30	2	36.6	6.6	36.3	6.7	1.0
						Average			4.6		5.1	0.86
1	19.0	SF	B	Pads	1,200	30	2	37.5	1.7	37.6	1.6	1.0
2	31.0	SF	B	Pads	1,500	30	1	36.0	2.4	36.2	2.8	0.85
3	19.0	SF	A	Sp. pl.	163	30	1	36.1	5.1	36.3	4.9	1.0
4	19.0	SF	A	Coil	163	30	3	37.5	3.1	37.5	2.3	1.35
5	31.0	SF	A	Coil	163-215	42	2	37.0	5.0	37.0	4.5	1.1
						Average			3.5		3.2	1.06

$\frac{M^*}{C} = \frac{\text{Rise °C. metal side}}{\text{Rise °C. control side}}$

TF — tantalum foil; SF — silver foil; Sp. pl. — space plate electrodes.

TABLE 7. — *Simultaneous Recording of Subcutaneous and Intramuscular Temperatures of Hindlimbs of Control Animals.*

No.	Weight (Kg.)	Location	Machine	Application	Power (Ma.)	Duration (Min.)	Trial	—Right— Initial Temp. °C.	—Right— Rise °C.	—Left— Initial Temp. °C.	—Left— Rise °C.	$\frac{R^*}{L}$
1	36.4	I.M.	B	Pads	1,500	30	1	34.0	3.0	34.7	2.0	1.5
2	22.7	I.M.	B	Pads	1,500	30	2	38.2	2.0	38.6	1.2	1.67
3	36.4	I.M.	A	Sp. pl.	190	30	2	35.2	1.8	35.3	2.8	0.64
4	22.7	I.M.	A	Sp. pl.	190	30	1	36.3	4.9	36.8	4.5	1.09
							Average		2.9		2.6	1.11
1	36.4	S.C.	B	Pads	1,500	30	1	33.0	4.5	34.0	3.0	1.5
2	22.7	S.C.	B	Pads	1,500	30	2	37.8	2.4	38.2	1.4	1.7
3	36.4	S.C.	A	Sp. pl.	190	30	2	34.3	2.2	34.8	2.8	0.79
4	22.7	S.C.	A	Sp. pl.	190	30	1	35.8	3.2	35.6	5.6	0.57
							Average		3.1		3.2	0.97

$^*\frac{R}{L} = \frac{\text{Rise °C. right side}}{\text{Rise °C. left side}}$

I. M. — intramuscular; S. C. — subcutaneous; Sp. pl. — space plate electrodes.

passage of short wave current the subcutaneous temperatures fell below the intramuscular levels. Both subcutaneous and intramuscular temperatures tended to remain elevated above the original level for several hours after the application of diathermy.

Throughout the study there was no tendency for one type of surgical metal to become more excessively heated than another by the short wave current. This is shown by the similarity in the M/C factor with tantalum, silver and stainless steel. Similarly, there was no evidence of selective heating of these metals either by the type of appartus used or by the method of application of the current to the animals. The heating of the tissues was directly proportional to the amount of power delivered.

Elevations of body temperature were proportional to the degree of heating of the hind limbs. With low to moderate dosage of short wave energy the usual body temperature rise was in the neighborhood of 1 to 2 degrees (C.). In those early experiments with high dosages which burned the tissues, rises of 4.5 degrees were obtained.

Tissue Reactions

Operative Procedure. — Rabbits and cats under pentobarbital sodium anesthesia were used in this investigation. Sterile precautions were observed.

In the first group of animals tantalum was implanted in both lower extremities. On the right side the sciatic nerve was exposed through a muscle-splitting incision and wrapped in tantalum foil. The foil was 26 mm. long, 20 mm. wide and 0.015 mm. thick. The foil surrounded the nerve approximately one and a half times. On the left side a small piece of tantalum sheet, measuring 20 mm. in length, 10 mm. in width and 0.4 mm. in thickness, was placed in an intramuscular pouch. The latter was formed by splitting the gluteal muscles vertically and then transversely. In this manner the flat surface of the metal came to lie more or less parallel to and 0.5 to 1.0 cm. below the skin surface.

Cats were used in the experiments designed to determine the effects of diathermy on the cerebral cortex underlying a metal skull plate. In these animals a disk of bone 20 mm. in diameter was removed at the vertex with a trephine. This skull defect was closed with a disk of tantalum of similar diameter and 0.38 mm. thick. The metal disks were held in position by bridging sutures extending across the vertex to approximate the temporal muscles. The skin was closed with interrupted cotton sutures.

Application of Diathermy. — The short wave diathermy was delivered in this series by machines A, B and C. Machines A and B have previously been described. Machine

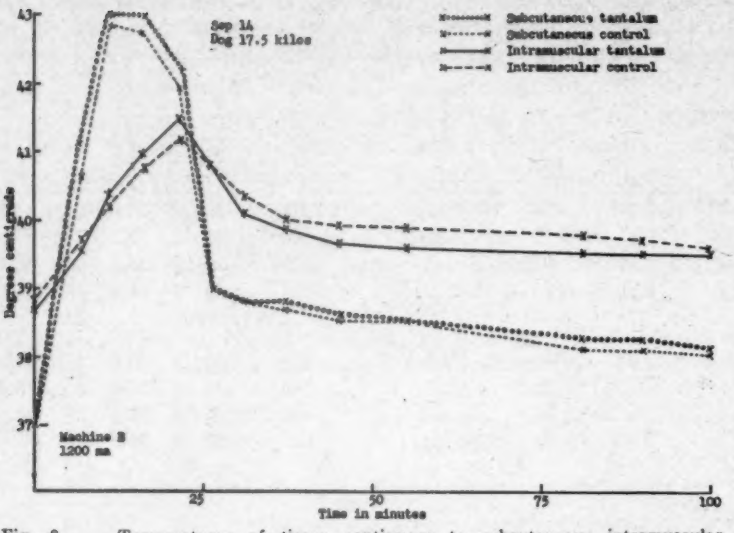

Fig. 2. — Temperatures of tissue contiguous to subcutaneous intramuscular tantalum plates before, during and after the passage of short wave diathermy.

C generates power at a fixed 18 meter wavelength, and a variable condenser in the patient circuit is provided to resonate the load with the oscillator. In this series, the power applied was reduced to as much as two-thirds of the recommended therapeutic dose.

The high frequency current was applied to the hindlegs one week postoperatively. In one group of animals only one application of diathermy was given, and in the other group daily applications were given for a period of one week.

With machine B the pad electrodes, as previously described, were placed over the lateral aspect of each hindlimb and centered over the metallic implant. A meter reading ranging from 800 to 1,600 ma was used. With machine C sponge rubber pad electrodes with gum rubber backs, 4 inches by 5 inches in size, were similarly placed over the lateral aspect of each hindlimb. These were separated from the skin by approximately ½ inch of felt spacing.

Diathermy was applied to the group of cats with cranial metallic implants by machines A and B. With unit A the space plates previously described were placed about 1 inch from the skin of the head on each side. With unit B the pad electrodes were similarly placed against either side of the head and a range of dosages previously noted was used. All applications were for twenty minutes.

Preparation of Histologic Specimens. — The cats in the tantalum cranioplasty experiments were anesthetized and perfused through the aorta with Ringer's solution followed by 10 per cent formalin solution. After hardening, the whole brain and its membranes were removed, and small sectors of the dura lying under and adjacent to the tantalum plate as well as the subjacent cortex were excised, embedded in nitrocellulose and sectioned 40 microns thick. The sections were stained with hematoxylin and eosin or with toluidine blue, cleared and mounted in clarite.

In the muscle and nerve examinations, the animals were killed and then bled. A large block of muscles containing the tantalum plate, about 3 to 4 cm. by 2 cm. by 1 cm. was removed, the tantalum plate withdrawn and the tissue fixed by immersion in formalin-Zenker solution. A length of sciatic nerve including the whole region enclosed by the tantalum cuff and normal nerve on each side was removed, oriented on a piece of filter paper and immersed in the same fixative. Muscles and nerves were embedded in nitrocellulose and sectioned longitudinally, the former at two levels (30 microns thick) and the latter along the middle (20 microns thick). Sections were stained with hematoxylin and eosin and mounted in clarite. The number of animals with implanted tantalum whose tissues were studied microscopically is shown in table 8.

Results of Histologic Examinations. — 1. Tantalum Cranioplasty Experiment: The cortex beneath the tantalum plate showed no signs of injury in all 6 animals, including those treated with instrument A or instrument B.

In 2 animals which did not receive diathermy the dura beneath the tantalum plate was markedly thickened because of an increased amount of

dense collagenic connective tissue containing appreciable numbers of pigment-containing cells, round cells and polynucleated giant cells. In 1 cat, treated with instrument A, and in 2 others, treated with instrument B, after a similar operation, the dura was thickened but less than in the control animals (table 9). In the 2 animals treated with instrument A the reactive cells were, in addition, less numerous.

2. Nerves: a. Tantalum collar around sciatic nerve, no diathermy. The epineurium was thickened, with gross and microscopic evidence of edema. Collagen was increased in amount, rather dense directly beneath the tantalum foil, and was infiltrated with numerous round cells, polymorphonuclear leukocytes and some pigment cells. The fat cells were atrophic, and

TABLE 8. — *Number and Intensity of Diathermy Treatments with Machines A, B and C in Relation to Location of the Metallic Implants.*

Location of Implant	No Treatment (Controls)	Diathermy with Machines A and C		Diathermy with Machine B	
		Small Dose	Large or Repeated Dose	Small Dose	Large or Repeated Dose
Epidural	2	2	2	2	0
Epineurial	5	7	7	9	8
Intramuscular	5	7	4	9	8

vascularity was greatly increased The perineurium, endoneurium and nerve fibers were normal.

b. Tantalum collar around sciatic nerve, treated with instrument C. With one exception, tissues treated with small doses (100 ma) showed no appreciable difference from untreated nerves. In 1 instance, when a deep burn had been inflicted as a result of diathermy, there was far less inflammatory reaction in the epineurium, while the remaining structures were normal (reduced response). With slightly larger doses (120 to 150 ma) the inflammatory reaction was more pronounced than in the untreated controls or showed the reduced response just described as a consequence of the burn. With repeated small doses (once each day for three, six or seven

TABLE 9. — *Relative Thickness of Dura Beneath Tantalum Implant and Control, Nontramatized Region About 1 Cm. Removed.*

Measures were made about 4 mm. from the falx cerebri in all cases.

Cat. No.	Treatment	Thickness of Dura Subjacent to Tantalum (microns)	Thickness of Nontraumatized Dura Not in Contact with Metal (microns)
1	None	304	38
2	None	418	53
3	Machine B	296	38
4	Machine B	242	65
5	Machine A	152	76

days) a reduced-type reaction took place, with some round cell infiltration in the endoneurium and possibly very slight focal axonal degeneration. This focal degeneration did not occur unless there was superficial burning.

c. Tantalum collar around sciatic nerve, treated with instrument B. With small doses (800 ma), the epineurial reaction was no more marked than in the untreated controls. With larger doses (1,200 or 1,600 ma) or with repeated exposure to diathermy of 800 ma once each day for seven days (severe burns occurring in most animals) the inflammatory reaction was no greater than in the untreated controls or was less marked. In some

of the animals that were severely burned, round cell infiltration in the endoneurium and questionable focal axonal damage occurred. Nerve damage occurred in no unburned animals and in only a few of those with severe burns.

3. Muscle: a. Tantalum implant, no subsequent diathermy. The newly formed dense connective tissue sheath which enclosed the tantalum plate was highly organized and rather narrowly limited to a zone about 65 to 325 microns thick. In 1 animal, there was some evidence of edema. The collagen was rather highly cellular and contained polymorphonuclear leukocytes, some round cells, fibroblasts and pigment cells. The leukocytes and fibroblasts were generally diffusely distributed; the pigment cells were commonly concentrated toward the muscle, while the round cells were more localized toward the tantalum plate. The reactive zone extended broadly into the substance of the surrounding muscle in 1 instance. The coagulum of the cavity containing the tantalum plate was generally cell free. Hemorrhage in the dense connective tissue took place in 1 instance. Muscle atrophy was usually confined to the immediate neighborhood of the sheath of connective tissue enclosing the tantalum; in 1 rabbit it extended centrifugally, accompanied with a diffuse inflammatory reaction.

b. Tantalum implant, treated with machine C. With small doses, of 100 ma, which did not burn the animal (with 1 exception), the range of inflammatory response to trauma was somewhat increased in two respects; (*a*) the cell density of the scar tissue and of the cavity containing the tantalum plate was generally increased, and (*b*) the reactive zone was generally thicker (65 to 455 microns). Giant cells were visible in the tissues of 1 animal. In the exceptional animal which sustained a severe burn as a result of 100 ma of diathermy, the reaction tissue on the deep side of the tantalum did not differ from that of the controls. Superficial to the tantalum plate, coagulation necrosis with marked edema, muscle fiber atrophy, giant cell formation and hemorrhage were apparent. Larger doses (120 to 150 ma) or repeated small doses on three or six successive days resulted in severe burns involving the skin and muscle.

c. Tantalum implant, treated with machine B. The muscle reaction in the region of the tantalum implant was essentially the same as in animals treated with machine C. In 6 out of a total of 11 rabbits subjected to a single dose of 800, 1,200 and 1,600 ma with machine B, there were no significant changes in the peritantalum tissue. The other 5 animals showed the typical picture of necrosis accompanying severe superficial burns. Of 2 animals treated with the smallest dose of diathermy for seven successive days, 1 showed no greater changes than occurred after a single exposure, while the second revealed evidence of some muscular atrophy with accompanying cellular infiltration and slight hemorrhage. In the second rabbit the peritantalum tissue was broader (160 to 680 microns).

Summary of microscopic findings. — 1. When the tantalum was epidural, diathermy appeared to cause a reduction in the thickness of the dural fibrosis occurring as a reaction to the presence of the tantalum plate.

2. When the tantalum was epineurial, single applications of diathermy in the smallest doses employed did not cause any additional change. When superficial burns occurred, the epineurial reaction was less marked than when no diathermy or smaller doses were used. Even in some of the animals with severe burns there occurred only slight axonal degeneration and endoneurial cell infiltration of no great significance.

3. When the tantalum was implanted in muscle, the smallest dose of diathermy used with machine C resulted in slight incremental damage of

questionable significance in all animals. In 1 animal, the same dose of diathermy resulted in evidence of superficial burns. Larger or repeated doses also caused severe burns. The smaller doses of diathermy with machine B seemed to cause the same incremental tissue damage in about half the animals treated; the other animals showed the typical picture of third degree burns. It is of interest that the tissue reaction of the unburned animals following diathermy with machine B was not more extensive than in rabbits treated with machine A, in spite of the fact that the dose employed appeared to be closer to the dangerous burn-inducing intensity with the former method of applying diathermy.

Comment

In the present study an attempt has been made to implant surgical metals in experimental animals in a manner simulating their use in human patients. Short wave diathermy has been administered to animals with tantalum skull plates, tantalum cuffs around nerves, tantalum and stainless steel plates lying next to the femur and tantalum wire in the subcutaneous tissues. The use of silver foil subcutaneously and epineurially and tantalum and silver plates intramuscularly, while not practiced clinically, does, however, contribute to the experimental comparisons. All conclusions drawn are based on the conditions established in this investigation. It is possible that heating of implanted metals might occur when a different method of diathermy application or a different type of metal is used. For example, it is theoretically possible that excess tissue heating might occur at the ends of a thin strip of metal with diathermy applied at each end.

In the first part of the investigation, when tissue temperatures were measured on the metal and the control sides, there was a general tendency for the metal side to become warmer. This is shown in the average *M/C* factors. However, when the temperature rises on the metal and the control sides are analyzed in detail, it is noted that there is no significant difference in temperature between the two sides, despite a high *M/C* factor. For example, the highest *M/C* factor was 1.77, and in this animal the temperature rises were 3.9 and 2.2 degrees Centigrade on the metal and control sides, respectively. (This slight tendency for the metal side to be warmer than the control side may be due to the retention of heat by the metal, since the control side would be more readily cooled by the circulation, or to an interference with circulation by the surgical procedures employed.) The importance of the circulation is stressed. We recognize the possibility that higher temperatures might be reached in tissues with a poor blood supply, e. g., bone or dense scar tissue. It is noted that the thermometers were calibrated to ± 0.5 degree (C.) and the temperatures therefore recorded are subject to a maximal error of 1 degree between the metal and the control sides. The stem correction factor has been largely reduced by inserting the thermometers to the same depth in each instance. Despite these sources of error, the use of the nonmetallic thermometers is a sufficiently reliable method of tissue temperature measurement as a basis for estimating tissue injury.

Study of the histologic reactions in tissues contiguous to metals has failed to disclose any evidence of significant destructive heating. When damage occurred, it was due to burning because the short wave energy exceeded the therapeutic range. The most conclusive evidence in support of this claim was the lack of destructive changes in most nerves wrapped in tantalum foil, even though the overlying skin and muscle showed third degree burns. The changes that occurred in the muscles surrounding the

metal plates in the unburned animals were slight and probably attributable to vasodilatation or manipulative trauma rather than to the effect of diathermy on the metal. True injury by diathermy should have been much more visible than it actually was.

There are several additional observations of interest in the studies of tissue temperatures. It was noted that whereas the subcutaneous temperatures were lower than the intramuscular temperatures before the application of short wave diathermy the reverse was true at the end of the trial. This subcutaneous hyperthermia subsided more quickly than the intramuscular temperature, so that within five to ten minutes it fell below the latter. In a few of the experiments the intramuscular temperature exceeded the subcutanous temperature throughout the passage of the current. The tissue temperatures remained elevated for periods up to three hours after the passage of diathermy. The body temperature was invariably elevated, the rise being directly proportional to the degree of hyperthermia in the hindlimbs.

Summary and Conclusions

1. Short wave diathermy, i. e., short wave radiofrequency, was applied to the tissues of experimental animals in which tantalum and silver plates, foil and wire and stainless steel plates were embedded. The metals were wrapped around the sciatic nerves or inserted into intramuscuar or subcutaneous pouches or fitted into skull defects over the intact dura.

2. There was no significant difference between the temperature on the side containing the metal and that on the control side, irrespective of the diathermy machine used, the method of application of the short wave energy or the nature of the metal used.

3. Histologic examination of tissues contiguous to the metals disclosed no significant destructive effects from diathermy attributable to the presence of the metal. When destructive changes occurred, they were equally extensive on the control side and were due to burning by excess heating. A striking finding was the lack of significant change in sciatic nerves wrapped in tantalum foil when the diathermy had caused a third degree burn of the overlying skin.

4. In all the animals in this series the major blood supply was anatomically intact. It is conceivable that when the circulation is impaired, either by trauma or peripheral vascular disease, tissue damage by the use of diathermy may result. It is standard practice to be extremely cautious in the use of diathermy in such patients.

The technical assistance of C. Masucci,, PhM3, VIO, U.S.N.R.; J. G. Wisda, PhM1c, V6, U.S.N.R., H. R. Bonsal, PhM1c, V6, U.S.N.R., and A. L. Goff, PhM2c, V6, U.S.N.R., in performing the experiments described in this report is gratefully acknowledged.

ROUND TABLE ON BIOPHYSICS AT MINNEAPOLIS

Readers are requested to submit questions to be discussed at the round table on Biophysics, which is planned as part of the annual session. Please direct your suggestions to Program Committee, American Congress of Physical Medicine, 30 North Michigan Avenue, Chicago 2.

THE EFFECT OF THE PRESENCE OF METALS IN TISSUES SUBJECTED TO DIATHERMY TREATMENT *

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It was observed in the earlier stages of the development of short wave therapy that metal particles, like rings, safety pins or buttons, on the surface of a patient under treatment might cause overheating or even burns. It is, therefore, a general rule to remove these metallic objects before a treatment. Very little is known, however, about whether metallic particles within the body, like broken needles, bullets or other objects, will also cause similar phenomena. Only Kowarschik[1] reported that metal wires within the tissue may become heated if oriented parallel to the direction of the applied field. On the other hand, it is known that the metallic fillings of the teeth have not caused any serious difficulties in the treatment. It has been suspected that the presence of implanted surgical metals may cause severe danger if the body is subjected to a short wave diathermy treatment.

There are two possibilities of heat damage resulting from the effect of short wave diathermy on implanted metals. First, the metal may be heated to such a degree that it can damage the contiguous tissue. Such an effect is to be expected only by treatment with the magnetic field (coil method) at comparatively low frequencies. The other possibility of danger may arise in electric fields (plate, cuff electrodes) where the presence of metal can lead to a field deformation and, therefore, a concentration of energy in the tissue adjacent to the metal.

It is difficult to predict the order of magnitude of these effects, since the geometric field distribution, the heat transfer characteristics of the materials involved and the influence of the blood circulation can be estimated to a limited extent only. The experimental approach seems, therefore, indicated. In the preceding paper, Etter, Gersh and Pudenz have done such work, with electric shortwave fields on animals, while this paper deals with similar experiments on models. This simplification in models has the advantage that the influence of different parameters can be studied in greater detail, while it is a distinct advantage of Etter, Gersh, and Pudenz's approach that the over-all picture and the order of magnitude of the effect in vivo can be obtained more clearly.

Experimental Set-Up

Containers of different sizes and shapes were filled with electrolytes and the tantalum tubes or sheets immersed in these solutions. The whole model was subjected to high frequency fields, using different electrodes in various positions. Frequencies from 10 to 55 Mc were used and the output power of the oscillators was varied from several watts up to 1 kilowatt.

The effect of field concentration or the resulting heat effect was made visible by thermal indicators. As such, mercury silver iodide was used first, sprinkled on the surface of agar blocks which were made conductive by addition of sodium chloride after the method described by Albrecht.[2] Occasionally, experiments were made with ground meat as the medium, and the

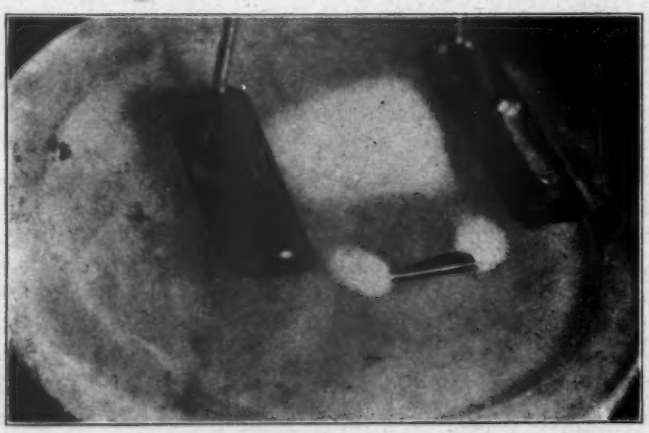
* From the Department of Biology, Massachusetts Institute of Technology.

1. Quoted by Bierman, W.: Medical Applications of the Short Wave Current. Baltimore, William Wood & Company, 1942, p. 134.
2. Albrecht, W.: Ztschr. f. d. ges. exper. Med. 93:816-821, 1934.

change of color of the meat at higher temperatures served as an indication of heat distribution. Later, according to a proposal of Dr. F. O. Schmitt, egg white or albumin solutions were used. This substance has three advantages: (1) It closely simulates the situation in vivo; (2) the point of dangerous heat is clearly indicated by sudden local coagulation, and (3) disturbing heat convection is limited by the high viscosity of the medium. The accompanying figure shows a typical picture obtained with this method.

Results

It appeared in almost every case that the presence of the metal had a pronounced effect upon the field distribution and the local development of heat in the models. The effect was very pronounced if the metal was located, partially or entirely, in the space between electrode and electrolyte. If the metal was embedded in the electrolyte but close to the surface (near the electrodes), the effect diminished, the more so the deeper the metal piece was located within the model. If the metal was implanted in the middle of the electrolyte and surrounded by highly conducting substances, the effect of field concentration was greatly reduced but still noticeable. These results are in agreement with the former observations, mentioned in the introduction, and the findings in the preceding paper and can be explained as follows: The lines of electric force and the high frequency current between the two electrodes follow the path of least resistance. The (complex) resistance of air is largest, the one of tissue (electrolyte) is smaller and the one of metal is the smallest. The presence of a metal object in air changes the field distribution substantially. This change is less if the metal is embedded in the tissue, because it is surrounded then by good conductors. The danger of an effect of field deformation and concentration through implanted metal increases as the metal represents a more appreciable part of the current path. This is the case (1) if the dimensions of the metallic object are large in the direction of the force lines, (2) if the metal is partly or entirely surrounded by mediums with low conductivity (air, subcutaneous fat tissue) or (3) if the metal is on or close to the surface.



Field-concentrating effect of tantalum

The usual form of field deformation is indicated in the figure. Without the tantalum tube T, the field strength would be a homogeneous band between the regions of both electrodes. The tantalum tube changes this picture in two ways: (1) The field adjacent to the walls of the tube (region *A*) is reduced (short circuited by the tube), and (2) the development of heat

on both ends of the tube (region *B*) is strongly increased as the result of the field concentrating effect. (The current uses the path through the metal instead of the one through the tissue.)

The effect depends, other things being equal, upon the time and intensity of the treatment and is very pronounced at short treatments with strong fields. At long treatments (twenty minutes) with low intensity, the heat exchange within the treated area tends to level off the differences and only a general homogeneous heat picture appears.

Conclusions

The reported experiments show that embedded metals in tissue subjected to electric high frequency treatments (with short wave condenser fields) tend to deform the field distribution and can lead to field concentrations. The experiments of Etter, Gersh and Pudenz, on the other hand, show that in experiments on animals no dangerous overheating could be observed in treatments at normal, clinically used, intensities. The apparent disagreement between the two results may find an explanation in the following way:

The presence of a field-concentrating effect of the tantalum, as illustrated in the figure of this paper, can be assumed in all the experiments reported by Etter, Gersh and Pudenz. In some of these experiments the temperature on the side of the metal is higher than on the control side. The authors attribute this effect partly to the interference with the circulation. The effect arises, however, primarily if the intensity of the treatment is high and the time short (e. g., table 3, experiments 2, 3, 7, 8, 10, 11; table 4, second part, experiments 1, 2, 4, 5; table 7, experiments 1a, 2a, 1b, 2b). As far as can be concluded from these tables, the phenomenon is the same as that described, i. e., clear indication of field deformation, which is, however, leveled off by heat conduction, if the intensity of the treatment is low and/or given over long times. This same phenomenon makes it also impossible to observe a histologic change in the tissue contiguous to the implanted metal. Heat conduction in the organism levels off these differences.

My conclusions are, therefore, that the experiments of Etter, Gersh and Pudenz show that for the investigated practical cases, primarily those in which tantalum is embedded deep into the tissue, the field concentration is of little practical significance. This result is, however, not to be generalized. Under certain conditions, as previously outlined, the field concentration provoked by implanted metals can well rise up to values that are dangerous to the tissue contiguous to the metal.

PHYSICAL MEDICINE AND COLD INJURY OF THE LIMBS *

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The subject of cold injuries of the limbs and their treatment is particularly appropriate for a meeting devoted to physical medicine — appropriate in the sense that the causative agent (in this case, cold) is a physical one and, more important, because in treatment physical measures play a stellar role.

Injuries produced by cold masquerade under many guises. Despite the romantic halo cast upon them, they all have one common basis, intracellular damage, which is roughly proportional to the intensity of the cold and to the duration of exposure.

Types of Cold Injury

Most familiar is ordinary "frostbite," occurring on exposure to temperatures below 32 F. This may occur to any one, anywhere, although as a general rule it is the poorly clad and indigent person who is the victim. During the late war, articles appearing on high altitude frostbite described it as if it were a new disease. It is only a new variety of an old disease and afflicts air force personnel, simply because they are exposed to the subzero temperature of the stratosphere. The touch of a bare hand upon cold metal or "bailing out" with unprotected hands and face may be as searing to the flesh as exposure to a naked flame. However, the term might apply without modification to mountain climbers, in whom the condition has long been known and who certainly are not in planes although they are up in the air.

Prolonged exposure to wet and cold at temperatures which are often above freezing produces another variety of cold damage, called trench foot in the foot soldier and immersion foot in the shipwrecked sailor. In both of these the intimate contact of cold water and skin readily and rapidly abstracts heat from the underlying structures even though the environmental temperature may hover around 45 or even 50 F. Secondary factors which aid in production of the picture or complicate it are dependency of the involved limbs, lack of energetic muscular movements, starvation and protein deprivation and maceration of the tissues by water with subsequent pyogenic infections.

In chilblain, or pernio, there is repeated cold trauma of the tip of the nose, the ears and acral portions of the limbs, especially the pressure or bunion areas. Eventually such regions remain red and painful even when the outside temperature is mild.

Finally, there is the so-called shelter foot, a condition found in debilitated and aged persons, who during the blitz on London were forced to sit in beach chairs in the cold and drafty subways. Circulatory impairment and even gangrene would develop, partly on the basis of cold and dependency but mainly because of pressure of the front bar of the chair upon the popliteal vessels.

Pathologic Physiology

Actual freezing of soft tissues occurs below a critical temperature of —21 F. with the formation of ice crystals in the cells, the lumens of vessels and tissue spaces. There is disruption of cellular boundaries and necrobio-

* From the Montefiore Hospital for Chronic Diseases.
* Read at a meeting of the New York Society for Physical Medicine at the New York Academy of Medicine, Oct. 2, 1946.

sis, involving deep as well as superficial structures. Above this temperature level, the direct effects are chiefly upon the outer covering of the limb; the deep effects are mediated through reflex arterial and arteriolar constriction unless the bulk of the tissue is so small, as in a finger, that direct action of the cold is possible throughout.

The effect of cold upon blood vessels is not selective; it affects all living cells impartially. It is simply because viability of tissues depend on an intact blood supply that brings the remote effects of circulation insufficiency into such prominence.

There are three main reasons why the extremities are so frequently involved by cold damage: 1. They are exposed so often. 2. Their insulation is not as good as that in other areas. 3. They are quick to reflect changes in environmental temperature by virtue of their heat-regulating function.

During the stage of exposure to cold, the member appears pale and generally feels "dead" or numb. Although the injury is already present it is only in the phase of thawing out that it becomes most evident. Dramatically, the algid state just described gives way to an intensive vasodilatation; the limb becomes warm and hot; noticeable swelling appears, and there is rapid formation of blebs and blisters and necroses. Intense burning pain is present. All these changes occur in response to the local accumulation of vasodilating metabolites as well as damage to the sympathic nerve fibers and other components of the peripheral nerves. It is at this time that the damaged vascular endothelium begins to swell and vacuolate and agglutinative thrombi so characteristic of the histologic picture form within their walls. Superimposed pyogenic infection is a frequent complication, but, fortunately, most patients pass into a chronic phase in which restorative processes are active.

In brief, the underlying pathologic physiology which is basic for all varieties of cold injury is as follows: an initial phase of vasoconstriction and cellular damage to all structures, either directly by cold or indirectly through the circulatory impairment, and then a rapid change to a second phase on warming, characterized by intense vasodilatation with the formation of multiple small vessel thromboses and further embarrassment of the peripheral vascular bed by a tremendous flooding of the tissues with edema fluid. If this is borne in mind, one will be better able to understand the objectives of treatment.

Treatment

Treatment of cold injuries up to the present time has been for the most part a makeshift affair. Even during the early part of World War II there was no unanimity in therapy; hence, patients at one hospital were subjected initially to sympathetic block, and at others they were treated by enthusiastic advocates of short wave diathermy, or Paevex and intermittent venous occlusion, even simple heating by means of a lamp or by whirlpool baths. Such enthusiasm, based on a failure to comprehend the physiologic basis for cold injury, speeded up and added to the destruction already present and countless toes and even limbs were lost through these well meaning but misguided therapeutic attempts.

If there has been one thing advanced in the treatment of early cold injuries it has been the minimizing of the destructive phase of arteriolar and capillary dilatation. The ideal treatment consists in essence of maintaining the affected limb uncovered in a cool room at a temperature between 65 and 70 F. and elevation of the involved extremities about 8 inches to facilitate venous return and absorption of edema. In this manner tissue metabolism

is lessened and vasodilatation lessened. It is a well established fact that in such low environmental temperatures the toe temperature conforms rather closely to the room temperature, whereas raising the room temperature to 75 to 80 F. frequently produces maximum vasodilatation in the toes, with temperature readings of 90 to 95 F.

Pain and swelling are more easily controlled at low temperatures; if it is deemed advisable in the particular case even lower local levels may be reached by cooling the feet with an electric fan or even local refrigeration with ice. In the acute stage it is of theoretical importance to know that heparin may prevent intravascular thromboses. This has been the basis of the treatment proposed recently by Lange and Boyd, but since the drug must be given within the first six hours after exposure in order to be effective, it is impractical in time of war. Personal experience is lacking in the use of this seemingly logical procedure.

The acute phase may last ten to fourteen days, but even during the latter part of this period it becomes imperative to start active motion in the form of graduated bed exercises, not to wait — as has been done on a number of occasions — until the joints are contracted, stiff or ankylosed by disuse and the underlying inflammatoin. The skin may come off the hand and foot as a complete cast, but, when one bears in mind how these finely balanced mechanisms are adversely affected by inactivity, motion must be insisted upon. This was done even with patients who had gangrene of the toes or forefoot, over the objections of physicians whose experience had only been with the gangrene of arteriosclerosis or thromboangiitis obliterans, an entirely different matter.

It was learned quite early that the extent of gangrene could not be determined by the line of demarcation at all. Most frequently the necrosis was superficial and would come off, leaving the underlying tissues intact, or if a line of separation developed it would be far distal to the original surface marking. This was a tremendous point against early operation. As soon as separation became inevitable, minimal surgical procedures through small incisions of a fish mouth type with removal of dead bone and necrotic tissue could be done. Infection could be easily controlled at any time with penicillin parenterally. In some few instances where the surrounding tissues were still inflammed or swollen, surgical intervention was contraindicated, but daily nibbling away with bone forceps and scissors might result in complete healing before long.

The use of metatarsal supports, arch supports, properly fitting and even roomy shoes in themselves could turn a bed patient into an ambulant patient. The importance of these devices cannot be overstressed. The anterior arches were frequently found sensitive to pressure and would produce a characteristic heel gait. Most persons had to use shoes two or three sizes larger than they had been wearing.

Sweating is extremely frequent and copious in the later stages of cold injury. It may literally drip from the skin and macerate it to the point that fungus infections often complicate the injury. As a matter of fact, since the cycle of events which led to the original injury, cold and wet, are again present, the disorder may reproduce itself. Topical application of aluminum chloride powder, frequent change of socks and other local remedies, have been found of little or no value. Atropine will cause a diminution of sweating, but its side effects on the salivary glands and eyes preclude its use. The method which has been found to be of practical value has been ion transfer of 1 per cent formalin solution. When given for one-half hour at 15 to 20 milliamperes for six treatments, it will reduce sweating in over 70 per cent

of the cases for from four to six weeks or longer. Courses may be repeated.

A few words should be said about sympathectomy and its place in late cold injury. To do such an operation because a limb remains cold, cyanotic or sweaty is, in my estimation, not justified. Even pain is not relieved, because it is the pain of a sensory neuritis or resolving inflammation or stiffness or a combination of all these in all the structures of the affected limb. To bear this out, the results of sympathectomy in late cold injury are equivocal and even disappointing. It has some rationale only in Raynaud's phenomenon, which occurs late as a result of blood vessel sensitization. Even here the amount of disability must be carefully weighed before the operation is carried out.

FROSTBITE *

Experimental and Clinical Observations

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CHICAGO

In the second World War personnel engaged in high altitude flying encountered changes in environmental temperatures from a range of +15 to +20 C. to a range of —45 to —60 C. Other personnel were stationed in areas where the temperature stayed between —45 and —60 C. for long periods. In spite of improved equipment and clothing and an educational program, frostbite occurred with sufficient frequency to present a considerable problem.

This article is a report on experimental frostbite in monkeys, on clinical frostbite of the hands in man and on treatment of frostbite in man and monkeys.

Experiments

A study was made of the early changes in the vascular system:

A monkey was wrapped with sufficient clothing to keep it warm at —40 C., and the hands and feet were exposed for fifteen minutes. One finger was amputated while it was frozen. Thereafter a finger or toe was amputated every hour for eight hours, after twenty-four hours and after forty-eight hours. After each amputation it was noted whether active bleeding occurred. The specimen was fixed in Zenker's solution, and histologic sections were made.

Bleeding did not take place from the frozen stump, but it followed all amputations up to five hours after the frostbite. The histologic sections first showed intimal edema and collections of leukocytes along the intimal wall. These changes were followed by arteritis with invasion of the media and adventitia by polymorphonuclear cells, edema and exudate in the perivascular tissues. The vascular changes occurred in the small, medium and large vessels. The later changes were associated with intravascular thrombosis.

This experiment indicated that in rapid frostbite the blood freezes and stops circulating. On thawing it becomes liquid and circulates until intra-

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vascular thrombosis takes place, which in this experiment occurred after about five hours.

An attempt was made to determine the effects of slow warming as compared with those of rapid warming of the frostbitten part. Greene[1] favors keeping the part cool in the early stages, while data presented by Davis, Scarff, Rogers and Dickenson[2] suggest that moderate warming is better. Russian reports[3] show a preference for rapid warming. Clinically, patients suffer more pain with rapid warming and seek a cool environment. A few experiments were done on monkeys in an effort to determine the degree of damage under the two conditions, but the results were inconclusive.

Experiments to determine the effects of pressure bandages were also inconclusive. Two are reported here:

The feet of the first monkey were exposed to a temperature of —40 C. for fifteen minutes. A pressure bandage of cotton waste and Ace bandaging was then applied to the left foot and remained in place for twenty-four hours. The monkey was allowed complete freedom in its cage and seemed to suffer little inconvenience from the frostbite or during gangrene and spontaneous amputation. Healing took place in less than three weeks. Colored photographs were taken during the process (fig. 1 *A* through *G*).

This experiment does not indicate that there are any beneficial or deleterious effects from the pressure bandage. It does, however, illustrate the rapid healing which is attributed to immediate and continued use of the feet during the healing process.

Fig. 1. — *A* through *G*, experiment on the therapeutic effects of pressure bandages on experimental frostbite. A monkey, wrapped in suitable clothing to protect the body and face but with the feet exposed, was placed in the cold chamber at —40 C. and left there for fifteen minutes. Immediately after the animal was removed from the chamber a pressure bandage of cotton waste and Ace bandaging was applied to the left foot; it was the intent to leave the bandage in place for twenty-four hours, but within that time the animal had pulled it off. The animal was allowed complete freedom in its cage; it seemed to suffer little inconvenience from the frostbite, gangrene and spontaneous amputations. Colored photographs were taken during and at various intervals after the frostbite.

A, control photograph. *B*, slate gray appearance of the toes during frostbite. *C*, pressure bandage in place. *D*, the feet one day after frostbite, with blister formation. *E*, two days after frostbite, showing denuded surfaces. *F*, seven days after frostbite, with beginning spontaneous amputation of the toes. *G*, eighteen days after frostbite, showing spontaneous amputation and healing almost complete.

Although neither beneficial nor deleterious effects of the pressure were shown in this experiment, rapid healing, attributed to the immediate and continued use of the feet during the healing process, occurred.

H through *N*, experiment to demonstrate the insulating effects of bandaging. A monkey, wrapped in suitable clothing to protect the body and face but with the feet exposed, was placed in the cold chamber at —40 C. and left there for fifteen minutes. The animal was then removed and a pressure bandage of cotton waste and Ace bandaging was applied to the left foot. A thermometer was incorporated in the bandage (as shown in *J*) and skin temperatures were taken at frequent intervals. After forty-five minutes a similar bandage was applied to the left foot. The animal was allowed complete freedom in its cage; it seemed to suffer little discomfort from the frostbite and appeared as active as the normal monkeys. Colored photographs were taken and at frequent intervals after the frostbite.

H, slate gray appearance of the frostbitten toes. *J*, method of studying the insulating effects of bandaging. *K*, bleb formation one day after frostbite. *L*, four days after frostbite, showing rapid progress of the gangrene. *M*, six days after frostbite, with further progress of the gangrene. *N*, twelve days after frostbite, showing beginning spontaneous amputation of the toes.

Although the observed skin temperature indicated that the bandaging exerted a pronounced insulating effect and provided slow warming in the left foot, no beneficial therapeutic effects from this procedure were observed. The rapid healing of the feet of this animal was attributed to the early use of the feet.

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1. Greene, R.: Frostbite and Kindred Ills, Lancet 2:689 (Dec. 6) 1941.
2. Davis, L.; Scarff, J. E.; Rogers, J. E., and Dickenson, M.: High Altitude Frostbite, Surg. Gynec. & Obst. 77:661 (Dec.) 1943.
3. The effects of Arctic Conditions Upon Human Behavior and Reactions with Special Emphasis Upon Russian Findings and Expeditionary Needs: Prepared by Dr. Gregory Razran. From the Office of Research and Development Division: Office of the Quartermaster General, War Department, Washington, D. C.

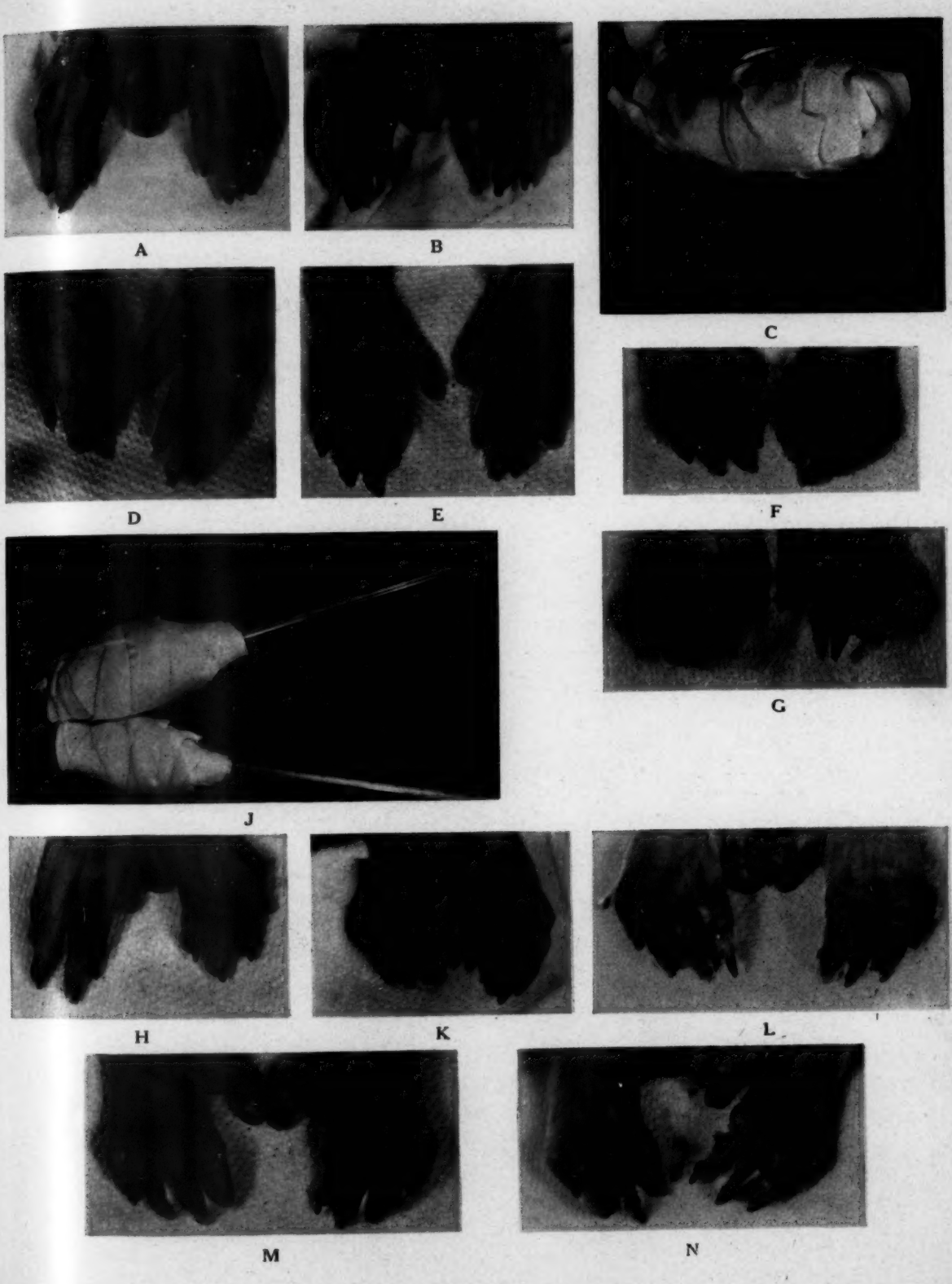

Figure 1

The feet of the second monkey were exposed to a temperature of —40 C. for fifteen minutes, which is ample time for severe frostbite to develop. A pressure bandage with a thermometer incorporated was applied to the left foot immediately after the animal was taken out of the cold chamber. Forty-five minutes later a similar bandage was applied to the right foot. Skin temperature readings were taken every ten minutes for one hundred and five minutes. The bandages were then removed and the monkey observed through the period of gangrene, spontaneous amputation of the toes and healing. The results of skin temperature studies, shown in the following tabulation, indicate that a pressure bandage has a marked insulating effect and

Results of Skin Temperature Studies

Minutes	Skin Temperature (C.) Right	Left	Procedure	Minutes	Skin Temperature (C.) Right	Left	Procedure
0	32	34	Control	45	29	12	Bandage Right
0–15	....	....	—40 C	55	30	15	.....
15	....	....	Bandage Left	65	31.5	23	.....
23	3	5	.....	75	32	28	.....
25	9	5	.....	85	32	31	.....
30	21	6.5	.....	95	32.4	32.4	.....
35	23	9.5	.....	105	32.5	33	.....
40	26	10.5					

prevents warming of the part if applied too soon after frostbite.

Colored photographs of the progress of gangrene and recovery are shown in figure 1 *H* through *N*. As in the preceding experiment, the monkey was allowed the freedom of its cage, with use of its fingers and toes, immediately after frostbite and throughout the gangrenous and healing phase. It seemed to suffer little during convalescence. No benefit could be demonstrated from the slow warming, but the stumps healed in a little over a month.

In a number of other monkeys, also, healing occurred in from one to one and a half months. This suggests that active use of the frozen part immediately after frostbite is desirable and that physical therapy should be instituted early and continued through the gangrenous stage. These remarkable results in monkeys may be contrasted with the comparatively poor results in the following case.

Report of a Case

A white man, aged 28, was first seen on June 5, 1936. He had been to a party on the evening of February 7, had become intoxicated and on his way home had fallen asleep on the sidewalk. The outdoor temperature was —12 F., and when he awakened he found that he had frozen his fingers. Examination on June 5 revealed spontaneous amputation of the fourth finger of the right hand at the first interphalangeal joint, amputation of the fourth finger of the left hand at the first interphalangeal joint and amputation through the distal end of the proximal phalanx of the third finger of the left hand (fig. 2). There was limitation of motion in all of the fingers, with discharging lesions of the second finger of the left hand and the fourth finger of each hand.

Roentgenograms (fig. 2) showed that the remaining portion of the phalanx of the fourth finger of the right hand was irregular and rarefied, with definite areas of dead bone. There were multiple pieces of loose bone in the soft tissues of the third finger of the left hand. The distal third of

the middle phalanx of the fourth finger of the left hand was irregular and showed a number of small pieces of dead bone. Considerable rarefaction involved the carpal bones of both hands.

The peripheral circulation was studied on June 5 with the digital plethysmograph[4] (fig. 3). The skin temperatures of the fingers were found to be

Fig. 2. — Photographs and roentgenograms illustrating extensive tissue damage and failure of healing four months after extensive frostbite of the hands (case reported in the text).

abnormally high, probably because of inflammatory change. The changes in pulse volume were within normal limits, as were the effects of local heat in producing vasodilatation.

4. Johnson, C. A.: The Digital Plethysmograph as a Measure of the Peripheral Circulation, Surg. Gynec. & Obst. 70:31 (Jan.) 1940.

The patient had had no treatment from the time of the accident to the time of the examination approximately four months. As a result the joints of the fingers had become stiff from both disuse and disease. The skin was tense and shining and bound down to the underlying structures. The patient was given intensive physical therapy of heat, massage and active

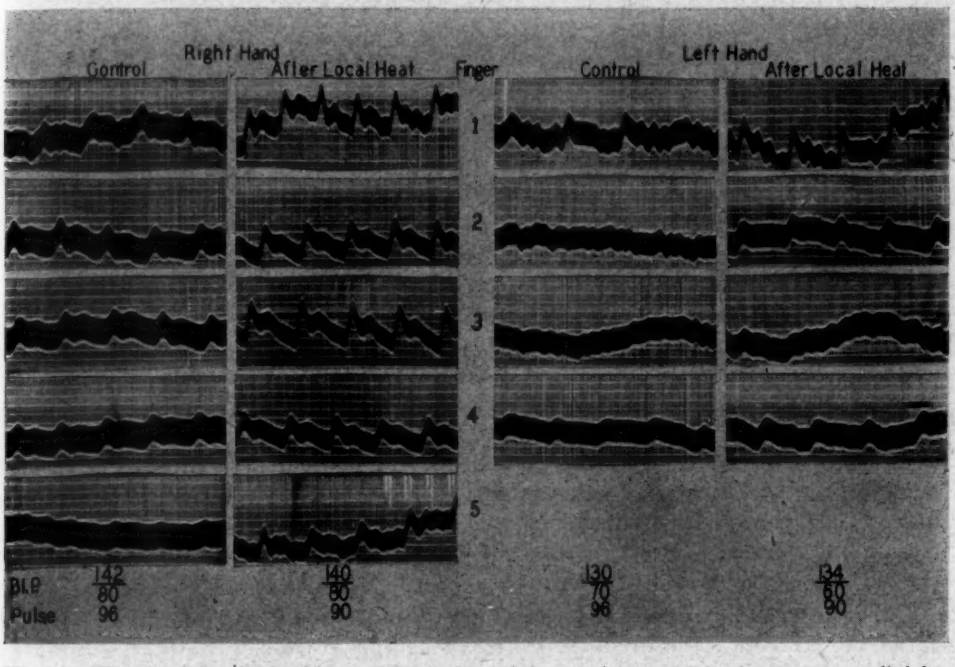

Fig. 3. — The circulation in the fingers of the patient whose case is reported in the text was studied by means of the digital plethysmograph. These studies show that the skin temperatures averaged about 30 C. in the fingers of the right hand and about 34 C in the fingers of the left hand. Circulation was adequate, and there was a normal vasodilating response to local heat.

motion of the joints in spite of the open lesions and attendant pain. He had a good functional result.

The results in this case suggest that use of the fingers and prompt physical therapy are desirable even in the presence of discharging lesions or pain. This is in keeping with the Russian views on treatment of frostbite.

Summary and Conclusions

This study is incomplete, and one hesitates to draw any definite conclusions. However, the experiments indicate that clotting of the blood did not occur until four to five hours after frostbite. Further studies on monkeys with some anticoagulant, such as heparin, are indicated. It is conceivable that patency of a sufficient number of vessels might be maintained to save some tissue from gangrene.

A study of experimental frostbite in human subjects was recently carried out by Lange and Loew,[5] using a different method. Their work also suggests that heparin may be useful in the early treatment of frostbite.

The rapid recovery of monkeys from frostbite and subsequent gangrene may be attributed to immediate active use of the affected parts. On the other hand, the slow healing in the reported case may be attributed to lack of use of the affected parts. It is recommended that physical therapy be started early even in the presence of pain and open lesions.

I wish to thank Dr. Edwin Hirsch for reviewing the histologic sections and for his interpretations of them.

5. Lange, K., and Loew, L.: Subcutaneous Heparin in the Pitkin Menstrum for the Treatment of Experimental Human Frostbite, Surg. Gynec. & Obst. 82: (March) 1946.

FACTORS TO BE CONSIDERED IN EVALUATING EFFECT OF TREATMENT IN ANTERIOR POLIOMYELITIS

With Special Reference to Improvement in Muscle Strength

NORMAN NELSON, M.D., Dr. P.H.

LOS ANGELES

There has been a considerable divergence of opinion in the medical profession concerning the relative value in altering muscle strength of various therapeutic procedures used in the treatment of the paralysis of anterior poliomyelitis. Hansson[1] (1942), in discussing the present status of physical therapy in anterior poliomyelitis, asked the question: "Why is it that such a divergence of opinion is found in a relatively short period of time concerning the treatment of poliomyelitis?" and answered himself, "This is undoubtedly due to the fact that it is extremely difficult to estimate properly the relative value of any particular form of therapy." In the present discussion I intend to show that this extreme difficulty in estimating the value of any given type of therapy is due, at least in part, to the presence of significant factors affecting the return of muscle strength, which are inherent in the recovery pattern of the disease itself and are independent of treatment. These factors undoubtedly have served to obscure and distort the picture of the effect of treatment.

The present paper is based on the study of the leg paralysis in 400 cases of paralytic poliomyelitis followed at the Harvard Infantile Paralysis Commission Clinic over a period of five years. This five year period was chosen arbitrarily because it was long enough to enable one to study the recovery of muscles over a significant period and still short enough not to cut down too much the number of cases available. All the leg muscles in the group of 400 patients which had an original paralysis grading of "gone," "trace," "poor" or "fair" were included. Because of their relatively large number yet relatively small importance, the only "good" muscles studied were a group comparable in size to the groups with the severe degrees of paralysis. My colleagues and I were unable to demonstrate any very significant difference in the improvement of muscle strength between the two sexes and between different age groups, and I have, therefore, not included these factors in this report.

There are two rather obvious factors which should be kept in mind in any evaluation of the results of treatment designed to influence muscle strength in poliomyelitis. The first is the variability both of severity of paralysis and of recovery pattern which may occur from epidemic to epidemic. The poliomyelitis, for instance, that has come under treatment at the Harvard Infantile Paralysis Clinic during the year 1942 has shown relatively more improvement than has the poliomyelitis of previous years. Had the type of treatment been radically changed during this time, it is obvious that the treatment would probably have received more of the credit for the result. The second factor which must be considered is the variability of muscle testing that occurs with different individuals. This factor does not, however, affect the present study a great deal because the method used at the Harvard Infantile Paralysis Clinic is objective (Merrill) and because

1. Hansson, K. G.: Present Status of Physical Therapy in Anterior Poliomyelitis, Physiotherapy Rev. 22:3, 1942.

all of the physical therapists at the Clinic in the last twenty-five years have been trained by the same director of physical therapy and are checked by her at regular intervals.

The usual method of determining the value of a given treatment is to compare the total early paralysis with the total late paralysis for various types of treatment and to calculate on some statistical basis the relative improvement shown in the groups treated. It is obviously difficult to determine with certainty the true effect of any treatment until one eliminates as variables factors of improvement inherent in the recovery pattern of the disease itself and independent of treatment and until one has a sufficient number of cases to allow such a breakdown. In this study there have been encountered two important intrinsic factors which I feel should be taken into consideration in the evaluation of the results of physical therapy in poliomyelitis.

Time of Original Examination

The first factor that must be standardized is the time of the original examination with respect to the onset of the disease. The rate of improvement is so rapid during the first two months that even a few weeks makes a tremendous difference in the eventual percentage recovery calculated. Thus, one cannot compare the improvement in different patients, as it is usually done, by calculating the percentage improvement based upon examinations made at the time of the patient's first visit to the clinic without regard to the time interval since onset, for this interval may vary anywhere from two weeks to three months.

If the various degrees of paralysis are given numerical ratings — a "good" muscle receiving a paralysis rating of 1; a "fair" muscle, a rating of

TABLE 1. — *Difference in Ultimate Prognosis Between Given Degrees of Paralysis at One Month and the Same Degree of Paraylsis in the Same Persons at Two Months.*

Original Paralysis of Muscles	Time of Examination After Onset	Number of Muscles	Average Paralysis to Begin With	Average Paralysis at Five Years (Ultimate Prognosis)	Percentage Difference in Ultimate Prognosis Between Given Degrees of Paralysis at 1 Month and Same Degree at 2 Months
	Months				Per Cent
Gone	1	81	5	3.76	13
	2	137	5	4.25	
Trace	1	108	4	3.03	11
	2	150	4	3.35	
Poor	1	240	3	1.66	43
	2	261	3	2.38	
Fair	1	211	2	0.51	67
	2	286	2	0.85	
Good	1	139	1	0.10	120
	2	349	1	0.22	
Total		1962			

2, and "poor," "trace" and "gone" muscles ratings of 3, 4 and 5, respectively —as has been done in other studies,[2] it is possible to evaluate statistically the amount of improvement that takes place over a certain specified length of time. On this basis, I have calculated in table 1 the ultimate prognosis and the percentage improvement which has taken place over a period of five years for each degree of severity of "original" paralysis as determined

2. Legge, A. T.: The Early Treatment of Poliomyelitis and the Importance of Physical Therapy, J. A. M. A. 107:633, 1936.

by examination one month after onset. The prognosis and percentage recovery were again calculated on the same group of patients and for the same degrees of "original" paralysis, this time determined by examination two months after onset. It may be seen that there is 43 per cent difference in the ultimate prognosis between a muscle that is graded "poor" at one month and a muscle that is graded "poor" at two months and that there is 67 per cent difference in the ultimate prognosis between a muscle that is graded "fair" at one month and a muscle that is graded "fair" at two months. The same degrees of "original" paralysis, therefore, have entirely different prognoses and show entirely different percentages of improvement depending on how long a period after onset the examination is made on which the original paralysis is based. From this fact it is obvious that a person with a given amount of paralysis at one month after onset can expect a considerably higher percentage of improvement at the end of five years than another person with the same amount of paralysis two months after onset. There is, moreover, every indication that the difference in prognosis between the same degrees of paralysis at onset and at the first month after onset is considerably greater even than the difference in prognosis seen between the first month and second month. The same specific time interval after onset must be chosen at the date of examination of "original" paralysis in order that improvement may be calculated on the same basis in all cases being evaluated.

Original Severity of Individual Muscle Paralysis

The second factor which may obscure or distort the picture of the effect of treatment is the original severity of paralysis of a muscle. It may be seen in table 2, which gives the percentage of improvement shown over a

TABLE 2. — *Percentage of Improvement of Muscles Paralyzed in Different Degrees of Severity.*

Degree of Original Paralysis	Number of Muscles	Average Paralysis at 2 Months	Average Paralysis at 5 Years	Percentage Improvement in 5 Years
Good	349	1	0.22	78
Fair	286	2	0.85	58
Poor	261	3	2.38	21
Trace	150	4	3.35	16
Gone	137	5	4.25	15
Total	1183			

period of five years for each degree of "original" (based upon examination two months after onset) severity of paralysis, that muscles graded "fair" at two months show an average of 58 per cent improvement over this five year period, while "poor" muscles show an average of only 21 per cent improvement and "trace" muscles only 16 per cent improvement. Thus, not only the ultimate prognosis of a muscle but the percentage recovery as well is very different for the degrees of severity of original paralysis. If, for instance, one fails to classify muscles by severity of the original paralysis, the presence of a greater number of severely paralyzed muscles in the control group would result in a relatively low percentage of recovery in the controls and in contrast would make the treatment appear very effective, while the presence of a greater number of severely paralyzed muscles in the treated group would result in a lower percentage recovery in the treated group and make the treatment appear harmful. In neither case would the true effect of the treatment be evaluated. It becomes important, therefore, in attempt-

ing to determine the effect of a given treatment, to compare improvement only in muscles with the same degree of original severity of paralysis.

This pronounced difference in ultimate prognosis and in percentage recovery expected in the various degrees of original severity of paralysis involves both a true physiologic and a false statistical difference. By "physiologic difference" is meant an actual difference in possible degrees of recovery of muscle strength between the various degrees of severity of paralysis, independent of the statistical method used to demonstrate it. By "statistical difference" is meant that by giving the various degrees of severity of paralysis numerical ratings and then comparing them with each other it is possible to obtain statistical differences that do not accurately represent the true picture.

Physiologic, or True, Difference. — In table 3 I have taken for illustration a group of patients all of whom have had the same treatment and have attempted to represent the true physiologic improvement for each degree

TABLE 3. — *Muscle Improvement Following Paralysis of Different Degrees of Original Severity.*

Improvement of Muscle Strength at End of 5 Years	Starting, Gone or Trace at 2 Months	Starting, Poor at 2 Months	Starting, Fair at 2 Months	Starting, Good at 2 Months
Nnmber Muscles Stayed Same	124	70	18	7
Nnmber Muscles Improved 1 Degree	55	43	39	128
Nnmber Muscles Improved 2 Degrees	17	58	144	.....
Totals	196	171	201	135

of severity of paralysis. It will be noted that many more "fair" muscles improve one or more degrees than do "poor" muscles and that many more "poor" muscles improve one or more degrees than do "gone" or "trace" muscles. Thus, for 18 "fair" muscles that did not improve at all there were 39 that improved one degree and 144 that improved two degrees; for 70 "poor" muscles that did not improve, however, there were only 43 that improved one degree and 58 that improved two degrees or more, and for 124 "gone" or "trace" muscles that did not improve there were only 55 that improved one degree and only 17 that improved two degrees or more. Muscles with different degrees of original severity of paralysis, therefore, show considerably different degrees of true, or physiologic, improvement.

Statistical Difference. — Statistical distortions arise in the use of any percentage method which attempts to compare changes that may occur in unequal quantities. For instance, one method of evaluation considers that complete recovery represents 100 per cent improvement. According to this method, a "good" muscle which returns to normal will show 100 per cent improvement, as would a "gone" muscle which returns to normal. These changes, however, obviously do not represent the same amount of improvement; they represent only the percentage variation from normal.

In one of the commonest methods of numerically grading muscle strength (used by Legge, 1936; "gone" muscle = paralysis of 5, trace muscle = paralysis of 4, fair muscle = paralysis of 3, etc.), one encounters marked statistical fallacies unless one compares improvement in different groups of muscles which have the same degree of original severity. For instance, it may be seen in table 4 that a "good" muscle which improves one degree will show an improvement of 100 per cent, whereas a "fair" muscle which

improves 1 degree will show an improvement of only 33 per cent. A patient may start out then with total paralysis mainly of "good" muscles. If all these "good" muscles improve one degree, he will show 100 per cent improvement. On the other hand, another patient may start out with exactly the same total rating involving, however, "fair" muscles. If all these improve one degree, he will show an improvement of only 50 per cent. Certainly one cannot say that the improvement in the first patient was twice as great as the improvement in the second patient.

Another possible method of statistical comparison gives the same value to the same degree of improvement, no matter what the possible improvement is. Thus, the change from a "good" muscle to a "normal" muscle and from a "gone" muscle to a "trace" muscle would be considered to represent the same amount of improvement. This is not a good comparison either, for while it is possible for a "gone" muscle to improve five degrees, it is possible for a "poor" muscle to improve only three degrees and for a "good" muscle to improve only one degree. On the other hand, a "fair" muscle may lose as much as three degrees of strength, while a "gone" muscle cannot possibly get worse. It is difficult—indeed, almost impossible—to compare with accuracy improvement between quantities which have such different possible end results.

TABLE 4. — *Effect of Same Degree of Improvement on Percentage Improvement Calculated for Different Degrees of Severity.*

Original Rating of Paralyzed Muscle	Numerical Rating	Improvement in Degrees of Rating	Final Numerical Rating	Per Cent Improvement
Good	1	+1	0	100
Fair	2	+1	1	50
Poor	3	+1	2	33
Trace	4	+1	3	25
Gone	5	+1	4	20

If, however, in evaluating different types of treatment in different groups of patients, one compares the improvement shown by "fair" muscles in one group with that shown by "fair" muscles in another group, the improvement shown by "poor" muscles in one group with that shown by "poor" muscles in another group and the improvement shown by "gone" muscles in one group with that shown by "gone" muscles in another, it is possible to compare the relative improvement shown in the two groups without making the statistical fallacies mentioned.

An Illustration of the Importance of These Factors

An excellent example of a fallacious conclusion reached as a result of these factors not being taken into consideration may be seen in a series of 19 cases taken from **Infantile Paralysis in Vermont.**[3] Table 5 gives figures once represented as showing that patients under skilled management, on the whole, attain a greater percentage recovery of muscle strength than patients under unskilled management. It is true that the average monthly percentage gain in the first group (55 per cent) is greater than that of the second group (20 per cent). It should be noticed, however, that in the first group treatment was begun, on the average, seven months after onset; in 5 out of 7 cases, treatment was begun within four months of onset. In the second group, on the other hand, treatment was begun, on the average, forty-eight months after onset; in only 1 case out of 12 was treatment instituted before four months. Thus, the author was attempting to compare the effect of

3. Infantile Paralysis in Vermont, 1894-1922. A Memorial to Charles S. Caverly, M.D., State Dept. Pub. Health, Burlington, Vt., Brattleboro, Vt.: The Vermont Printing Company, 1924, p. 270.

TABLE 5. — *Result of Muscle Training.**

Age	Time Since Attack	Interval Covered by Tests	Average Monthly Gain of Affected Muscles in Per Cent
	Patients treated daily at office by skilled assistants.		
22	1 mo.	6 mo.	24
8	3 mo.	5 mo.	26
9	3 mo.	6 mo.	21
9	21 mo.	10 mo.	20
14	4 mo.	4 mo.	172
8	15 mo.	7 mo.	100
8	3 mo.	6 mo.	30
	Patients treated at home by relatives or nurses (unskilled).		
10	1 yr.	6 mo.	2
30	5 mo.	1 mo.	44
24	6 yr.	3 mo.	4
10	2¼ yr.	8 mo.	13.5
11	6 yr.	5 mo.	17
4	1 yr.	7 mo.	4
11	9 yr.	2 mo.	17
10	3 yr.	4 mo.	3.5
10	5 yr.	7 mo.	None
14	8 yr.	8 mo.	8
16	2 mo.	3 mo.	206
8	1 yr.	7 mo.	28

* From Lovett, 2 years.

skilled treatment on a group of patients early in the disease, at a time when considerable improvement can still be expected, with the effect of unskilled treatment on a group of patients late in the disease, at a time when expected improvement is very small. It is an interesting coincidence that the 1 patient in the group receiving unskilled treatment who was seen early in the disease (two months after onset) shows the greatest average monthly gain of all.

Summary and Conclusions

In this study I have presented factors commonly neglected in evaluating the effect of therapy on muscle strength in poliomyelitis and have suggested methods of avoiding fallacies introduced by them. These factors and their corresponding suggestions are:

1. The time of original muscle examination in relation to onset of the disease: The possible percentage improvement is considerably more for a given degree of paralysis at one month after onset than for the same degree of paralysis at two months. The date of the examination from which percentage improvement is calculated must, therefore, be standardized for all patients being evaluated.

2. The original severity of paralysis of each muscle: In evaluating the relative improvement in any two groups of patients only the same degrees of original severity should be compared. Thus, the improvement in "fair" muscles in one group may be compared only with the improvement in "fair" muscles in the other group, etc. By doing this one avoids statistical and actual fallacies involved in any comparison of unequal quantities.

Unless these factors are taken into consideration, the application of a treatment which has no effect on the paralysis of poliomyelitis to patients with mild degrees of paralysis early in the disease may appear on the surface to yield remarkable results, while the application of the same treatment to the same patients later in the disease or to patients with severe paralysis may appear actually to do harm. In neither case would the true picture be obtained.

PROGRESS REPORT

On the Development of the Department of Physical Medicine at the University of Southern California *

By O. Leonard Huddleston, M.D., Ph.D., Director of Physical Medicine, University of Southern California School of Medicine and the Los Angeles County General Hospital, Los Angeles

The establishment of a department of physical medicine at the University of Southern California was made possible largely by a grant from the Baruch Committee on Physical Medicine. It has been organized to include physical therapy, occupational therapy and certain phases of medical rehabilitation. Facilities of the Medical School and of the Los Angeles County General Hospital have been employed in the organization of the department. Steps have been taken to integrate and coordinate the activities of each in order to establish maximum teaching facilities and to provide the best possible medical care for the patients.

At the present time the department of physical medicine is set up to include three basic functions: (1) teaching, (2) clinical practice and (3) research. The activities of each, however, are integrated as much as possible.

Teaching

The facilities of the entire department are used for the purpose of teaching. Instruction in physical medicine is provided for graduate physicians, medical students and physical therapy and occupational therapy students.

Postgraduate Instruction for Physicians. — The training program for physicians attending the graduate school includes lectures, demonstrations and clinics. Provisions have been made for physicians to obtain practical, personal experience in the use of various equipment and procedures employed in physical medicine. Plans have been made for the development of refresher courses designed primarily for general practitioners and for physicians of the Veterans Administration who have been assigned to physical medicine departments of Veterans' hospitals. The department of physical medicine at the Los Angeles County General Hospital has been recognized as an accredited training school for residents and fellows. Such training may be credited toward specialty board requirements.

Instruction of Medical Students. — A comprehensive program for the instruction of medical students in physical medicine has been worked out. Certain phases of the subject are to be presented during each of the four years of medicine. In the freshman year classes in physical education have been incorporated in the medical curriculum. Practical experience in gymnastics, calisthenics and therapeutic exercise constitutes the major portion of this course. During the sophomore year, courses are to be given in kinesiology and therapeutic exercise. In the junior year a series of lectures and demonstrations are presented which deal specifically with the physical and physiologic attributes of the different modalities used in physical medicine. Also some consideration is given to the indications and contraindications for the use of physical agents in the various branches of medicine and surgery. During the senior year the class is divided into three sections and rotated through the department. Further demonstrations are presented in the use of equipment, and an opportunity to obtain personal experience with various physical modalities is provided so that each student receives an application of each physical agent and participates in the administration of various kinds of treatments used in physical medicine. Examinatoin of patients and practice in prescription writing are also included in the training program.

Training School for Technicians. — Physical therapy and occupational therapy training schools have been established and form a part of the College of Letters, Arts and Science. Both are located on the campus of the University of Southern California. The medical director of these two schools is a staff member of the Medical School. A physical therapy clinic has been set up on the campus to serve as a clinical training center for the physical therapy students.

Physical Medicine Clinic

The department of physical medicine is located on the main floor of the Los Angeles County General Hospital. Routine treatments for inpatients and outpatients of the hospital are provided by the department. A large therapeutic swimming pool provides facilities for pool therapy and underwater exercises. The medical gymnasium has been combined with the occupational therapy department so that the therapeutic exercises for patients may be supplemented by occupational therapy.

Special diagnostic and treatment clinics have been organized and incorporated in the department. One has been established for the study and treatment of peripheral vascular diseases. A convalescent "polio clinic" has been organized to provide adequate follow-up examination and treatment of patients with anterior poliomyelitis. It

(Continued on page 368)

* Abstract of a paper read at the Twenty-Fourth Annual Session of the American Congress of Physical Medicine, New York, Sept. 6, 1946.

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.·. EDITORIALS .·.

PHYSICAL MEDICINE AT THE CENTENNIAL MEETING OF THE AMERICAN MEDICAL ASSOCIATION

Physical medicine is arriving at another milestone of progress at the forthcoming meeting of the American Medical Association. A Session on Physical Medicine will be held on Thursday, June 12, 1947, as part of the Section on Miscellaneous Topics; a panel discussion on physical medicine in general practice, with Dr. Frank H. Krusen, as moderator, forms part of the program. As part of the general exhibits, there will be also a Special Exhibit on Physical Medicine, including Occupational Therapy and Rehabilitation — the variety and practical aspects of which exhibit promise to surpass even last year's imposing one at San Francisco; in connection with this exhibit there will be also showing of a special motion picture exhibit of the Committee on Physical Medicine. Physical Medicine was never accorded so much recognition at any meeting of the American Medical Association. However, the recognition was well earned by the continued progress in recent years and the hard labors of many earnest workers. The session at the meeting of the American Medical Association was established following the recommendation of the Consultants on Education of the Council on Physical Medicine. The same consultants also recommended that an American Board on Physical Medicine be established. It is confidently hoped that this recommendation will also be acted on favorably and thus the full recognition of Physical Medicine as an integral and at the same time quite distinct part of the practice of medicine be consummated. In the meantime let us hope that there will be a very large attendance at all of the occasions announced and that all physicians interested in physical medicine will sign in as attending the Special Session.

THE MEDICAL SERVICES OF THE VETERANS ADMINISTRATION

Anyone who has visited Veterans hospitals — misnamed "facilities" under the preceding regimen — since the inauguration of the present reorganized administration cannot help to be greatly impressed by the new spirit and quality of the medical service and by the cheerful attitude of the patients. Covalt's paper[1] in this issue of the ARCHIVES describes the broad scope of the physical medicine and rehabilitation program and its integration with a residency program with leading medical schools. Conceived to give the veteran the best medical service available, the results of this new over-all medical work have gained the unqualified support of the medical profession and completely changed its opinion of the medical services of the

1. Covalt, Donald A.: Physical Medicine and Rehabilitation in the Veterans Administration, Arch. Phys. Med. 28:327 (June) 1947.

Veterans Administration, characterized less than two years ago as "the backwash of medicine."

It is a regrettable anti-climax that just as this purposefully planned and well executed medical program is coming into full swing the ax of politically inspired economy has struck. The sudden retrenchment to make deficiency appropriations for the V. A. program has resulted not only in restriction of recruiting necessary personnel, in prohibition of travel for professional supervision and in suspension of essential training programs but has also reawakened the lurking doubts in many medical minds whether it ever will be possible under any system of political supervision to live up to the ideal of rendering scientific, dignified, yet thoroughly individualized medical care. Let us hope that the repercussions of the disappointment over this unexpected setback and the proof brought by General Hawley, Chief Medical Director, that the patient-day cost is less than in comparable civilian hospitals will serve to safeguard against a recurrence of attempts of a false economy, and that the Veterans Administration and its present high type medical staff and other personnel can continue to provide better medical care to our veterans than they have ever received.

THE DANGER OF METALS IN THE DIATHERMY FIELD

The spectacular advent of short wave diathermy some fifteen years ago raised a number of problems as to its physical and physiologic effects and their bearing on practical uses. Extensive clinical and experimental work solved most of these problems and established the scope of employment and the safeguards of the technic of diathermy as a deep tissue heating agent. Among the earlier assertions disproven was the claim that certain wavelengths exert selective heating in the living tissues; it was shown that the blood flow and the rapid interchange of heat in the living body will equalize any difference in heating of heterogeneous tissues in the depth. It was also shown that wavelength in itself plays a less important role in heating than the power output of the apparatus, the energy delivered to the patient and the technic employed. In recent years with the increase of implanting metals in the tissues of the body by surgery a newer problem, came to the fore, that of the potential danger of postoperative use of diathermy in these cases. Two comprehensive studies presented in the issue of the ARCHIVES should clarify this bothersome question. The observations of Etter[1] and al., started as a wartime research, disclose that histologic examination of tissues contiguous to metals showed no evidence of destructive effects from diathermy under ordinary treatment conditions. To a certain extent this appears to be in accord with the earlier cited observations about equalization of heat in the deeper tissues. Lion's[2] experimental set-up corroborates the fact that with metals embedded deep in the tissues, the field concentration is of little practical significance; however, overheating of tissues may still occur around metallic parts located on or near the surface. Hence it may be safely stated that with surgical metals situated in the deep tissues and with no evidence of impaired circulation there is no danger of overheating with diathermy when standard clinical intensities are applied with the usual careful technic.

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1. Etter, H. S.; Pudenz, R. H., and Gersh, I.: The Effects of Diathermy on Tissues Contiguous to Implanted Surgical Metals, Arch. Phys. Med. 28:334 (June) 1947.
2. Lion, K.: The Effect of the Presence of Metals in Tissues Subjected to Diathermy Treatment, Arch. Phys. Med. 28:345 (June) 1947.

COMBATING FRAUDULENT DEVICES AND FALSE CLAIMS

The enactment of the Federal Food, Drug and Cosmetic Act in June, 1938 for the first time brought under Federal control instruments, apparatus, and contrivances intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease, or to affect the structure or function of the body of man or other animals. This legislation is broad in its scope since it requires truthful labeling, safe use, adequate directions for use and adequate warnings against misuse for all diagnostic and therapeutic devices.

One of the early corrective actions brought under this statute was a seizure of a shipment of a device consisting of two metal plates, one made of copper and the other zinc, to be worn in the shoes of the user to produce electricity in the human body and thus promote health and vigor, relieve the stiffness of old age, rid the blood of uric acid and be efficacious in the treatment of high blood pressure, low blood pressure, asthma, paralysis, rheumatism and many other unrelated diseases. This represents one of the most flagrant violations encountered. Included among the various types of devices which have been the bases of legal actions are vibrators for reducing; infra-red lamps for the treatment of colds, backaches, rheumatism, sinusitis; diathermy for home use; foot exercisers for the treatment of weak arches, flat feet and other involvements of the feet and legs; lead nipple shields for lactating mothers (dangerous to health in view of the fatal lead poisoning which might result in infants); complex electrical devices intended for use in a wide variety of conditions, including special electric vibrators and magnetic belts; colored lights for all ailments of whatever kind; rectal dilators for permanent relief of constipation and piles (dangerous to health when sold indiscriminately); defective prophylactics; and chlorine generators for diseases of the respiratory tract.

This representative list of various types of devices indicates the wide variety of instruments against which action has been taken. Misleading claims are being made for devices still on the market. It is only through close cooperation of the experts in the field of physical medicine that the Food and Drug Administration will be able to proceed effectively against these.

In order to marshal technical information and assistance with regard to allowable, truthful therapeutic claims, adequate directions for use and adequate warnings against misuse of the wide number of devices encountered on the market, the President of the American Congress of Physical Medicine recently appointed a special committee to cooperate with the Food and Drug Administration, through its Medical Division.

The Food and Drug Administration, of itself, cannot condemn devices. This can only be done through legal actions brought in the Federal courts. In order to proceed effectively against such misbranded units in an effort to protect the public, the cooperation of experts in the field of physical medicine is required to provide testimony in court cases, as well as to conduct special investigations with regard to the clinical usefulness, if any, of certain devices so that court actions will result in favorable verdicts.

It cannot be emphasized too strongly that the protection provided by the Act from adulterated and misbranded devices is an extensive, far-reaching and continuing task. The American Congress of Physical Medicine can continue to make a valuable contribution in its interest to protect the public health and welfare in assuming the leadership in working out the numerous scientific and technical problems which are and will ever be present in the field of devices.

PROGRESS REPORT

(*Continued from page 364*)

includes a fully equipped medical gymnasium, an office and examination room for muscle testing and an electrodiagnosis laboratory which includes electromyography. This clinic has been financed in part by the local chapter of the National Foundation for Infantile Paralysis, Inc.

Ward Program. — Certain of the physical therapists are assigned to some of the wards throughout the hospital to give treatments to bedridden patients or to aid in such procedures as gait training, manual traction and assistive exercises. Other physical therapists are assigned to the Communicable Disease Hospital for the treatment of acute poliomyelitis patients during the quarantine period. All physical therapy, including the administration of hot packs, muscle reeducation, therapeutic exercise and progressive graded stretching, is carried out by the department of physical medicine. "Polio wards" at the Rancho Los Amigos have been assigned to the department of physical medicine for further treatment and care of "polio patients" after they have been discharged from the Communicable Disease Hospital at the end of the quarantine period.

Research Program

Two separate research laboratories have been developed. Both have been financed in part by grants from the Baruch Committee on Physical Medicine and from the National Foundation for Infantile Paralysis, Inc. One is located on the campus of the university and has been set up to collaborate with the department of anatomy; the other is located at the Los Angeles County General Hospital. The laboratory on the university campus is concerned largely with the study of functional anatomy, using slow motion moving pictures and high speed x-ray motion pictures, while the one at the hospital is concerned largely with clinical research. Ample facilities are available for certain types of basic research in neuromuscular physiology at the hospital laboratory. The hospital laboratory is equipped to record myograms, electromyograms, electroneurograms, electrocardiagrams, polysphygmograms and various types of clinical tests and measurements, such as electrodiagnostic tests, chronaxie measurements, strength duration curves, skin temperature determinations and measurements of muscle power and the range of motion of joints. Plans have been made also to provide equipment for recording auditory phenomena, such as heart tones, murmurs, normal and abnormal sound phenomena of such things as speech and audio frequencies; thermocouples for the determination of temperatures of the skin; body orifices and skeletal muscles, and, finally, a fairly complete photographic studio and darkroom accessories for both still and moving pictures.

Fellows and residents in physical medicine will be assigned to work on special problems either in basic science or in the clinical laboratory. Graduate students in physical therapy, occupational therapy and physical medicine are permitted to work on special problems in either laboratory.

Although many of the plans of the department of physical medicine are in the process of development and the equipment and personnel necessary to carry them out have not been procured fully, the outlook for an early realization of the proposals appears encouraging at the present time.

Your attention is called to page 321 where the outline and schedule of subjects for the annual instruction course appear. You are urged to attend and make your selection of lectures as early as possible. In any event if you plan to come to the Minneapolis session make your hotel reservations early.

ATLANTIC CITY
PROGRAM

Session on Physical Medicine
Atlantic City

American Medical Association, Claridge Hotel

Thursday, June 12—2 p. m.

Officers of Session

Chairman—FRANK H. KRUSEN, Rochester, Minn.
Secretary—GEORGE M. PIERSOL, Philadelphia.

Address of Invited Foreign Guest: The Relationship of Physical Medicine to Industrial Medicine (Lantern Demonstration).
D. Y. SOLANDT, Toronto, Canada.

Rehabilitation of Paraplegics.
EARL C. ELKINS, Rochester, Minn.

Psychiatric Aspects of Physical Medicine (Lantern Demonstration).
ARTHUR L. WATKINS and JACOB ELLIS FINESINGER, Boston.

Fundamentals of Physical Medicine of Interest to the General Practitioner.
STEVEN M. HORVATH, Philadelphia.

Intermission

Panel Discussion on Physical Medicine in General Practice

FRANK H. KRUSEN, Rochester, Minn., Moderator

Physical Treatment of Arthritis.
WALTER M. SOLOMON, Cleveland.

Physical Medicine in the Treatment of the Aged.
WALTER S. MCCLELLAN, Saratoga Springs, N. Y.

Physical Medicine and Backache.
FRANK R. OBER, Boston.

Physical Treatment of Common Dermatologic Conditions (Lantern Demonstration).
ANTHONY C. CIPOLLARO, New York.

Physical Medicine in the Management of Fractures (Lantern Demonstration).
E. KNAPP, Minneapolis.

Special Exhibit on Physical Medicine

The Special Exhibit on Physical Medicine at the Annual Session of the American Medical Association, Atlantic City, June 9 to 13, 1947 includes Physical Therapy, Occupational Therapy and Rehabilitation. It is presented for the second time under the auspices of the following committee: Frank H. Krusen, Rochester, Minn., Chairman; Winfred Overholzer, Washington, D. C., and Howard A. Rusk, New York.

The subjects covered in the exhibit, with the demonstrators in charge, are as follows:

KURT LION, Massachusetts Institute of Technology, Cambridge, Mass.:

Technology and Physical Medicine: This exhibit will deal with the fundamentals of biophysics and instrumentation as related to practice of and research in physical medicine.

KHALIL G. WAKIM, Mayo Foundation, University of Minnesota, Rochester Minn.:

Experimental Research in Physical Medicine: This exhibit will present recent developments in experimental research concerning high frequency radiation (microwaves) for heating of living tissues and also studies on the effects of physically induced fever on flow of blood.

FRANCES HELLEBRANDT, Baruch Center on Physical Medicine, Medical College of Virginia:

Clinical Research in Physical Medicine, Disability Evaluation: This exhibit will demonstrate methods of clinical research in physical medicine and elucidate particularly the employment of ergographs and other measuring devices in the evaluation of disabilities commonly encountered in the practice of physical medicine.

LIEUT. COL. BENJAMIN A. STRICKLAND, JR., Physical Medicine Consultants Division, Office of The Surgeon General, War Department, Washington, D. C.:

Dynamic Physical Reconditioning: This exhibit will demonstrate the methods developed in army hospitals for reconditioning convalescent and disabled persons.

DONALD COVALT, Division of Rehabilitation and Physical Medicine, Department of Medicine and Surgery, Veterans Administration, Washington, D. C.:

Physical Rehabilitation for Hemiplegia: This exhibit will demonstrate the use of physical therapy, occupational therapy and physical rehabilitation in the management of persons having hemiplegia.

ROBERT L. BENNETT, Warm Springs Foundation, Warm Springs, Ga.:

Physical Rehabilitation for Poliomyelitis: This exhibit will describe the use of physical therapy, occupational therapy and physical rehabilitation for persons having poliomyelitis.

WINTHROP M. PHELPS, Children's Rehabilitation Institute, Baltimore:

Physical Rehabilitation for Cerebral Palsy: This exhibit will present the methods of employing various phases of physical medicine for rehabilitation of persons having cerebral palsy.

HOWARD F. POLLEY, Mayo Foundation, University of Minnesota, Rochester, Minn.:

Physical Rehabilitation for Arthritis: This exhibit will deal with the employment of physical procedures for rehabilitation of persons having arthritis.

HENRY H. KESSLER, New Jersey Rehabilitation Clinic, Newark, N. J.:

Physical Rehabilitation of Amputees: This exhibit will present methods of rehabilitating persons who have major amputations of upper or lower extremities.

MEDICAL NEWS

The Spring Session of the Eastern Section—American Congress of Physical Medicine

As usual, balmy spring weather prevailed on Saturday, April 12, 1947, to help make a success of the New York Meeting. Rivals in the way of making traveling difficult was the Army Day Parade and in the matter of noise making was the circus opening across the street from the Polyclinic Hospital. Standing room only was the rule in a very short time. The Old Guard from far and near turned out in force. Eager, young faces were many, bespeaking a continuation of this specialty to which many of us have given our lives.

The Department of Physical Medicine was early crowded by those coming to look it over under the guidance of Dr. Kovács and his staff and, to view at close range "The Exercises Following Thoracoplasty," shown by Dr. Goldberg and his group and "The Heavy Resistance Exercise," demonstrated by Dr. DeLorme. It was difficult to get the audience out of the clinic.

"Kinetic Analysis of Crafts and Occupations," by Dr. Sidney Licht, was discussed by Miss Marguerite Abbott, Miss S. Ackerman of New York and Dr. Rudolph of Reading, Pa.; from the flow of words and the flashing sparks, the discussion was spirited, indeed. Occupational therapy seems a nice quiet subject but apparently there are many fighting words requiring definition, by both New England and New York, lest the fur fly.

Dr. Janet Travell, daughter of one of our charter members, brought us up to date on "Multiple Uses of Local Block of Somatic Trigger Areas." This was an excellent paper and pointed out the possibilities for those cases, resistant to our own methods; in conjunction with Dr. Scarff's "Problems of Therapy in the Paraplegias," we had an insight into the amount of ground work to be covered before physical therapy can be started.

As physicians our first duty is to help the patient by whatever method best serves. We do not continue treatment that does not help quickly if a better one presents itself.

"Curare and Intensive Physical Therapy in Anterior Poliomyelitis," a color and sound film prepared by Dr. N. S. Ransohoff, gave a colorful demonstration, well received, of a new technic, still under critical evaluation.

Discussion of these subjects by Drs. Schmidt, Mauriello, Hennemuth, Abramson and Harpuder, brought out some interesting points.

The evening session opened with anticipation of the interesting essays scheduled. Dr. McClellan, the President, brought greetings from the Congress as a whole to the chapters represented. In the absence of Dr. Watkins, Dr. Sidney Licht spoke for New England, Dr. Jerome Weiss spoke for Dr. Schepps who was ill, on behalf of Kings County. Dr. Harpuder gave a cordial welcome to all visitors for the host chapter, the New York Society of Physical Medicine, Dr. Martucci gave greetings from Pennsylvania, Dr. Barger from Washington. Dr. White, President of the New York County sent best wishes and Dr. Anderton, Secretary of the State Medical, was with us at dinner.

"Use of Radioactive Isotopes in Medicine," by Dr. I. D. Stein, "The Acclimatization to Hot Environment," by Dr. R. C. Darling and "Cardiovascular Responses to Stress," by Dr. Ludwig W. Eichna and their discussion by Drs. Lefkoe, Farrar, Barger, McClellan and Martucci made the evening well worth while. There was a rising vote of thanks to all the speakers, to Dr. Martucci as Chairman, Dr. Harpuder as Secretary, to Dr. Kovács and Dr. Warshaw for their attention to necessary details about the hospital and to Mr. Jaller the Superintendent for his courtesy and the efficiency of his official family in helping to make the meeting a success.

Madge C. L. McGuinness,
Secretary,
New York Society of Physical Medicine.

Need for Male Physical Therapists

The Veterans Administration through Dr. Donald Covalt has expressed the opinion of the urgent need for more trained male physical therapists. The future demand for these persons will continue for some time to come. The situation is so critical that the approved schools are asked to try to encourage more male students to enroll. Others in the field of physical medicine are urged to interest qualified young men to enter this field with the purpose of taking part in our program for the care of veterans.

Members of Staff of Baruch Center of Physical Medicine of the Medical College of Virginia Participate in Medical Gatherings

The Virginia Academy of Science held its annual session in Charlottsville, May 8 to 10. Among the speakers from the staff of the Baruch Center of Physical Medicine of the Medical College of Virginia, were: Josephine J. Buchanan, "Clinical Evaluation of Prostigmin in Selected Cases"; C. B. Cosby, "Some Observations of Temperature Induced According to the Mode of Application and Type of Diathermy Field," "Ultraviolet Transmission of Some Medicinals and Cosmetics Encountered in Ultraviolet Treatment"; Ellen Duvall and F. A. Hellebrandt, "Aptitude Testing in Physical Therapy"; Ernst Fischer, "A Simple

Model for Demonstrating the Effects of a One-Joint Muscle on the Various Joints of a Limb"; Sara Jane Houtz and Ellen Duvall, "The Validity of the Hand Dynamometer"; Annie Parrish, Helen Skowlund and Ellen Duvall, "The Influence of Vasodilator Drugs on Recovery From Fatigue"; V. W. Ramsey, E. G. Huf and Ernst Fischer "Adenosinetriphosphatase Activity of Myosin"; and Helen V. Skowlund, "Wrist and Radio-Ulnar Ergographs."

At the meeting in Chicago, May 18 to 22 of the Federation of Experimental Biologists, speakers from the same staff were: Ernst Fischer, E. Huf, V. W. Ramsey and K. W. Ryland, "Adenosinetriphosphatase Activity of Myosin From Denervated Skeletal Muscle"; F. A. Hellebrandt, Sara Jane Houtz and Ellen Duvall, "Influence of Mecholyl and Histamine Iontophoresis on Recovery From Fatigue," and M. Katharine Cary, Frank L. Apperly and F. A. Hellebrandt, "The Influence of Various Physical Therapeutic Measures on the Course of Gravity Shock."

Meeting of Association for Physical and Mental Rehabilitation

The Association for Physical and Mental Rehabilitation will meet at the Hamilton Hotel in Chicago, June 5 to 7, 1947. Some of the speakers on the program will be: Donald A. Covalt, M.D., assistant medical director, medical rehabilitation, Veterans Administration; Howard A. Rusk, M.D., professor physical medicine, New York University and chief consultant, Veterans Administration, branch office No. 7; Charles O. Molander, M.D., director of physical medicine, Michael Reese Hospital, Chicago; Louis B. Newman, M.D., physician-in-charge, medical rehabilitation, Veterans Administration Hospital, Hines, Illinois; F. H. Ewerhardt, M.D., medical director, school of physical therapy, Barnes Hospital, St. Louis; John E. Davis, Sc.D., chief, corrective physical rehabilitation, Veterans Administration; Josephine Rathbone, Ph.D., professor of physical education, Columbia University; George T. Stafford, Ph.D., professor of physical education, University of Illinois and consultant in physical reconditioning, U. S. Armed Forces; C. H. McCloy, Ph.D., professor of physical education, Iowa State University and K. Peterson, M.A., chief consultant, corrective physical rehabilitation, Veterans Administration.

College of American Pathologists

The College of American Pathologists with headquarters in Chicago is a new organization formed on December 13, 1946, at which time the Constitution and By-Laws were agreed on and the Board of Governors was elected.

The objectives of the organization are (a) To foster the highest standards in education, research and the practice of pathology; (b) through study, education and improvement of the economic aspects of pathology, to advance the science of pathology and to improve medical laboratory service to physicians, to hospitals and to the public; (c) to maintain the dignity, precision and efficiency of the specialty of pathology as defined for the service of the common good.

Membership, fellowship and founding fellowship are limited to pathologists who are certified by the American Board of Pathology. Arrangements have been made for junior membership, which is limited to residents in pathology who have completed two years of their requirements for examination by the American Board of Pathology.

The officers are F. W. Hartman, M.D., president; Granville A. Bennett, M.D., vice-president; Tracy B. Mallory, M.D., secretary-treasurer and M. G. Westmoreland, M.D., executive secretary. The members of the Board of Governors are Everett L. Bishop, M.D., Ward G. Cook, M.D., Oscar D. Hunter, M.D., Frederick H. Lamb, M.D., Thomas B. Magath, M.D., Tracy B. Mallory, M.D., James B. McNaught, M.D., Josiah J. Moore, M.D., and F. William Sunderman, M.D.

Dr. Elkins Speaks at Iowa State Medical Meeting

Dr. Earl C. Elkins of the Mayo Clinic, Rochester, participated with Drs. Ralph K. Ghormley, Gaylord W. Anderson and Lee F. Hill in a symposium on poliomyelitis held as a part of the ninety-sixth annual session of the Iowa State Medical Society at its recent meeting in Des Moines.

Dr. Molander Speaks at Battle Creek

For the program of the Professional Staff of the Percy Jones General Hospital one of the speakers was Dr. C. O. Molander who spoke on the clinical application of physical medicine, on Monday, May 26.

Dr. Dow to Georgetown

Georgetown University School of Medicine announces the appointment of Dr. Robert F. Dow as associate professor of medicine and head of the Department of Phyical Medicine.

Dr. Jessie Wright Speaks on Physical Medicine

Dr. Jessie Wright of Pittsburgh spoke on "The Responsibility of Physical Medicine in the Treatment of Poliomyelitis" at the ninety-ninth annual session of the South Carolina Medical Association, May 7, at Myrtle Beach, South Carolina.

"Low Back Pain" was the subject of her address at the Spring Seminar of the Allentown (Pa.) Hospital Association. "The Prescription of Physical Therapy" was presented by Dr. Wright at the meeting of the Fayette County (Pa.) Medical Society.

Research on Cerebral Palsy

A Joint Committee for Research in Problems of Cerebral Palsy has been established. Participating in the program are New York, Bellevue and Presbyterian hospitals, the City Health Department, Cornell University Medical College, Columbia University College of Physicians and Surgeons and the New York University College of Medicine. The committee will conduct research, intensify the development of diagnostic procedure and study the best way to organize, finance and operate clinics. Dr. Philip D. Wilson is chairman of the joint committee, and Dr. William Cooper, both of the Hospital for Special Surgery, is secretary; other members are Drs. Samuel Z. Levine, Howard A. Rusk, Edwin G. Zabriskie, William B. Snow, Samuel M. Wishik and Mr. Willard S. Simpkins.

Paraplegic Centers

The Veterans Administration has established seven paraplegic centers in hospitals strategically located from coast to coast. These centers, especially designed to treat veterans with spinal cord injuries, are in operation in Veteran Administration hospitals at Framingham, Mass.; Memphis, Tenn.; Van Nuys, Calif.; Staten Island, N. Y.; Richmond, Va.; Bronx, N. Y., and Hines, Chicago.

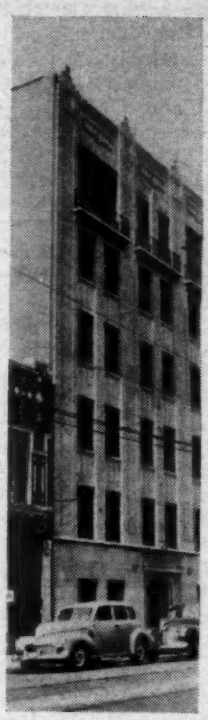
Because of a general shortage of doctors, physical therapists and others qualified to treat paraplegic patients, Veterans Administration personnel skilled in this field have been assembled at the seven centrally located hospitals. Today, because of modern medical sience and developments in the field of physical medicine, many persons with paraplegia are able to lead active, productive lives. To treat each case properly, the services are needed of a medical team consisting of a neurologist, neurosurgeon, psychiatrist, urologist, plastic surgeon, orthopedic surgeon, physical therapist, occupational therapist, corrective physical rehabilitation officer, educational retraining officer, prevocational shop supervisor, social worker and nurses. The Veterans Administration has about 1,200 veteran patients suffering from injuries to the spinal cord.

Rehabilitation

At the first public meeting of the newly organized Connecticut Rehabilitation Association, held recently in New Haven, Dr. Howard A. Rusk, head, department of rehabilitation and physical medicine, New York University College of Medicine, and associate editor of the New York *Times*, spoke on "Restoration of the Disabled to Useful Living."

American Occupational Therapy Association

The American Occupational Therapy Association is holding its national convention, Oct. 31 to Nov. 7, 1947, at the beautiful Hotel Del Coronado across the bay from San Diego in California. It is the 30th anniversary of the association and plans are being made to have the biggest and best convention ever.



Clinic of Physical Medicine

The only hospital in the United States devoted entirely to the practice of physical medicine has been opened in Chicago. The Medical Director is Dr. Milton G. Schmitt. Among the many interesting features are the especially designed gymnasium, swimming pool and solarium.

Norton Medical Award Invites Manuscripts

W. W. Norton & Company are again offering the Norton Medical Award for book manuscripts written for the lay public by professional workers in the field of medicine. Terms of the award have been slightly altered. The publishers now set no final closing date for the submission of manuscripts which may be submitted at any time, the award not being limited to any one year. The Norton Award offers $5,000 as a guaranteed advance against royalties. Either complete manuscripts or detailed table of contents together with one hundred pages of manuscript may be submitted. A descriptive folder giving full details of the terms of the award may be secured on request from the publishers, W. W. Norton & Co., Inc., 101 Fifth Avenue, New York 3, N. Y.

Books that have previously won Norton Medical Awards are The Doctor's Job, by Carl Binger, M.D.; Doctors East, Doctors West, by Edward H. Hume, M.D., and A Surgeon's Domain, by Bertram M. Bernheim, M.D., published this spring.

Need at Hines for Physiatrists

There is an urgent need for physiatrists at the Veterans Administration Hospital, Hines, Illinois. This hospital has approximately 3,000 patients. The Physical Medicine Service includes patients from Medical, Surgical, Neuropsychiatric and Tuberculosis Services. If interested, please write to Dr. K. A. Carroll, Manager, stating training, background and experience, in Physical Medicine.

Dr. Warren to California

Dr. Stafford L. Warren, professor of radiology in the University of Rochester School of Medicine, has been appointed dean and professor of biophysics in the University of California Medical School at Los Angeles.

Rehabilitation

Dr. Henry H. Kessler, Newark, N. J., member of the New Jersey Rehabilitation Commission, recently returned from Puerto Rico, where he conducted clinics on the rehabilitation of workers incapacitated by industrial accidents. Dr. Kessler was medical director of the New Jersey Rehabilitation Commission from 1925 to 1941.

Medical Bills Introduced in State Legislation

New Jersey. — S. 49, to amend the law relating to the practice of chiropody, redefines chiropody as follows: "the diagnosis of or the holding out of a right or ability to diagnose any ailment of the human foot, or the treatment thereof or the holding out of a right or ability to treat the same by any one or more of the following means: local medical, mechanical, minor surgical, manipulative and physiotherapeutic or the application of external medical or any other of the aforementioned means except minor surgical and local medical to the lower leg and ankle for the treatment of a foot ailment; not including, however, the treatment of tuberculosis, osteomyelitis, malignancies, syphilis, diabetes, tendon transplantations, bone resections, amputations, fractures, dislocations, the treatment of varicose veins by surgery or injection, the administration of anesthetics other than local, the use of radium, the use of x-rays except for diagnosis, or the treatment of congenital deformities by the use of a cutting instrument or electrosurgery. The term 'local medical' hereinbefore mentioned shall be construed to mean the prescription or use of a therapeutic agent or remedy where the action or reaction is intended for a localized area or part."

South Carolina. — S. 254, which passed the senate March 25, proposes to authorize osteopathic physicians licensed in the state to certify birth and death certificates in the same manner as is now prescribed by law for other physicians.

Texas. — H. 40, which passed the house April 1, proposes creation of a Texas Board of Chiropractic Examiners and defines chiropractic to be "the employment of objective or subjective means, without use of drugs or surgery, for the purpose of ascertaining the alignment of the vertebrae of the human spine, and the practice of adjusting the vertebrae by hand to correct any subluxation or misalignment thereof."

Vermont. — S. 38, which passed the senate March 22, to amend the law relating to the practice of osteopathy, proposes to designate such practitioners as osteopathic physicians and surgeons, rather than practitioners of osteopathy, and to authorize such practitioners to issue certificates relative to the commitment of insane persons, and such reports and certificates should be accepted equally with the reports and certificates of physicians of other schools of medicine. The proposal would, in effect, authorize such physicians to have the same rights with respect to the rendering of medical service under the provisions of public health, welfare and assistance laws and regulations now or hereafter in force as are possessed by the regularly licensed physicians and surgeons in the state. The proposal would also require osteopaths to have preliminary training including one year of internship in a hospital approved by the board.

Wisconsin. — A. 421, to amend the law relating to chiropractic, proposes to require chiropractic applicants to have graduated from a school of chiropractic approved and recognized by the board of examiners. S. 421 proposes the creation of a state board of examiners in naturopathy and defines naturopathy as "the prevention, diagnosis and treatment of human injuries, ailments and diseases by means of any one or more of the material methods or agencies of healing as taught by approved schools of naturopathy, said methods or agencies including dietetics, phytotherapy, vitamin or mineral or glandular food supplementations, irrigations, inhalations, external applications, physiotherapy and electrotherapy. The practice of naturopathy shall exclude the practice of medicine, surgery, obstetrics, osteopathy, chiropractic and the use of drugs. The practice of naturopathy shall exclude the treatment of cancer, tuberculosis, gonorrhea, syphilis, diphtheria, scarlet fever, typhoid fever, smallpox and fractures."

Colorado. — S. 453, to amend the law relating to the practice of chiropody, proposes to define the practice of chiropody as "the diagnosis and medical, surgical, mechanical, manipulative and electrical treatment of ailments of the human toe, foot and leg, excepting any amputation and excepting the administration of an anesthetic other than local." The proposal also defines the term "toe, foot and leg," "amputation," "diagnosis," "medical treatment," "surgical treatment," "mechanical treatment," "manipulative treatment" and "electrical treatment."

Kansas. — H. 327 proposes the creation of a naturopathic examinating board and defines naturopathy as "the prevention, diagnosis and treatment of human injuries, ailments and diseases by means of any one or more of the psychological, physical or mechanical, chemical or material forces or agencies of nature."

Oklahoma. — H. 51, which was approved March 17, amends the chiropractic act by requiring, as a

condition for annual renewal of a license, that the applicant present satisfactory evidence that he has attended a two day educational postgraduate program during the prior year or that he was unavoidably prevented by sickness or otherwise from attending such program. H. 159, which was approved March 13, requires various practitioners of the healing art to list descriptive letters after their names in order to designate the branch of practice in which they engage.

Pennsylvania. — H. 493 proposes the creation of a state board of massage examiners and defines massage as the art of body massage either by the hand or by mechanical apparatus, oil rubs, hot and cold packs, cabinet baths (excluding fever therapy), tub, shower, sitz and similar baths.— Rep. J. A. M. A. **133**:872 (Mar. 22); 1017 (Apr. 5); 1220 (Apr. 19); 1947.

BOOK REVIEWS

THERAPEUTIC EXERCISE. By *F. H. Ewerhardt,* M.D., Assistant Professor of Physical Medicine, Washington University School of Medicine and Barnes Hospital, St. Louis, Missouri, and *Gertrude F. Riddlé,* B.S., R.N., R.P.T., Instructor, School of Physical Medicine, St. Louis University School of Nursing, St. Louis, Missouri. Fabrikoid. Price, $2.50. Pp. 152. Philadelphia: Lea & Febiger, 1947.

The purpose of this little manual is to provide students of physical therapy, occupational therapy and physical education with a concise treatment of the subject, suited to their varied backgrounds. It contains chapters on joint motion, muscles participating in joint movements, physiology and skeletal muscle, the brachial and lower extremity plexuses, physiology of therapeutic exercise and its special and general applications in medicine, poliomyelitis and spastic paralysis.

The physician prescribing corrective exercise must, of course, not thumb through a well-worn notebook to find the set of exercises laid down for the case at hand, let us say a case of scoliosis, and let it go at that. On the contrary, he must have an unconscious background of comprehension of the normal physiology of the structures involved and must judge the manner in which it has been disordered by injury or disease. The improvisation or recall of appropriate exercises to attain the end desired is then quick and facile. Similarly the technician must not in a rote manner learn and teach in turn to his patient a stereotyped routine. Exercises applied in such an unthinking manner are doomed to fail, or worse, to compound the ill.

The authors from their rich experience in the field of therapeutic exercise have accordingly attempted to set down in brief form the basic principles involved, illustrating by typical examples of exercises they have found valuable and citing pitfalls to be avoided. These practical applications are the most valuable parts of the volume.

Less satisfactory are the sections devoted to theoretical aspects of nerve and muscle physiology, particularly of the central nervous system. These elements are admittedly difficult to present to therapists and students of physical education. A lengthy presentation would be inappropriate; one too brief is likely to be puzzling and to leave misconceptions.

The text would have benefited by a more generous use of diagrams and figures.

PHYSICAL MEDICINE IN GENERAL PRACTICE. Edited by *Arthur L. Watkins,* M.D., Associate in Medicine, Harvard Medical School; Chief of Physical Medicine, Massachusetts General Hospital, Boston, Mass.; Consultant in Physical Medicine and Medical Rehabilitation, Region No. 1, Veterans Administration. Foreword by *George Morris Piersol,* M.D., Professor of Medicine and Vice Dean of Medicine, Graduate School of Medicine, University of Pennsylvania. Cloth. Pp. 341. Price, $5.00. Philadelphia: J. B. Lippincott Co., 1946.

The subjects discussed cover the fields of medicine, surgery and the specialties in which physical medicine has proved of value. This is a "must" book for those physicians interested in physical medicine, as can be seen by the list of contributors. Dr. Frank H. Krusen of the Mayo Clinic discusses the history of the development of physical medicine; Dr. Earl C. Elkins of the Mayo Clinic, some factors to be considered in prescribing physical medicine; Dr. Richard Kovács of New York, physical therapy in medical conditions; Dr. Anthony C. Cipollaro of New York, the use of physical agents in dermatology; Dr. W. H. Northway, San Francisco, the principles of physical treatment of minor injuries; Dr. Miland E. Knapp, Minneapolis, physical medicine in the treatment of fractures; Dr. John G. Kuhns, Chief, Orthopedic and Surgical Staff, Robert Breck Brigham Hospital and Assistant in Orthopedic Surgery, Harvard Medical School, physical therapy in some common orthopedic disabilities; Dr. Arthur L. Watkins, physical medicine and

neurology; Dr. Robert L. Bennett, Warm Springs, Ga., physical medicine in acute and convalescent poliomyelitis; Dr. Volta R. Hall, Medical Director, King Sanatorium and Hospital, physical and occupational therapy in psychiatry; Dr. George G. Deaver, New York, rehabilitation and employment, Dr. O. Leonard Huddleston, Los Angeles, aspects of physical therapy and reconditioning in some of the army hospitals; Dr. H. Worley Kendell, Chief, Physical Medicine, University of Illinois College of Medicine, fever-chemotherapy; Dr. Frederick M. Allen, Professor of Metabolism, New York Polyclinic Medical School, use of cold in medicine and surgery.

The technical side of physical medicine is minimized and the above contributions are of prime interest to practicing physicians and surgeons. No aspect of this broad subject is stressed unduly and the content is well balanced. It should be in the library of every physican and surgeon.

THE PHYSIOLOGICAL BASIS OF MEDICAL PRACTICE. By *Charles Herbert Best,* C.B.E., M.A., M.D., D.Sc. (Lond.), F.R.S., F.R.C.P. (Canada), Professor and Head of Department of Physiology, Director of the Banting-Best Department of Medical Research, University of Toronto, and *Norman Burke Taylor,* V.D., M.D., F.R.S. (Canada), F.R.C.S. (Edin.), F.R.C.P. (Canada), M.R.C.S. (Eng.), L.R.C.P. (Lond.). Fourth Edition, revised. Fabrikoid. Price, $10.00. Pp. 1169, widely supplied with photographs, charts and diagrams, and extensively documented. Baltimore: The Williams & Wilkins Company, 1945.

The fourth edition of Best and Taylor's "The Physiological Basis of Medical Practice," has undergone several modifications from the previous editions. It is entirely reset in a large, double column format. The majority of the figures have been reduced in size. Most of the topics in the book have been brought up to date. The section on intracellular oxidation and the biological transformation of energy has been rewritten and kept abreast of the advances in this very labile and rapidly developing subject.

As usual the authors have treated the subjects in sufficient detail from the basic as well as clinical points of view to make the book valuable to students, specialists and general practitioners who are interested in correlating clinical conditions with the basic principles of physiology. The authors are to be congratulated on incorporating as much as they did of the new and worthy material which appeared in the literature since the previous edition. This has helped keep their book abreast of the times and maintain the excellent standard with which the first edition started.

In the opinion of the reviewer this book is very valuable to the medical profession as a whole because constant contact with the details of physiology and their clinical interpretation as made possible by use of the book will make the physician well aware of the idea embodied in the quotation "physiology is the golden gate into medicine."

THE NEW SCIENCE OF SURGERY. By *Frank G. Slaughter,* M.D. Fabrikoid. Pp. 286. Price, $4.00. New York: Julian Messner, Inc., 1946.

This book is written in popular style and brings considerable detailed scientific information to the lay public, many of whom have great curiosity about medical topics. Some background of knowledge of anatomical and chemical terms is necessary to understand the subjects presented, although technical explanations and scientific arguments are omitted. This should be interesting reading for a great variety of people connected with science and some physicians not closely in contact with surgery.

The scope of the book is astoundingly large covering such topics as new surgical procedures on heart, lungs, nerves, brain and blood vessels, anesthesia, antibiotics, liver function, diabetes, hypothermia, psychosurgery, burns, plastic surgery, cancer, tropical medicine and economic problems in medical care.

THEORY OF OCCUPATIONAL THERAPY. By *Norah A. Haworth,* M.A., M.R.C.S., L.R.C.P., D.P.M., Industrial Medical Officer, and *E. Mary MacDonald,* Principal, Dorset House School of Occupational Therapy. With a foreword by Sir Robert Stanton Woods, M.D., F.R.C.P., Consultant Adviser in Physical Medicine to the Ministry of Health, Physician in charge of the Department of Physical Medicine at the London Hospital. Third edition. Cloth. Price, $2.50. Pp. 158, with 75 illustrations. Baltimore: The Williams & Wilkins Co., 1946.

The third edition of this volume contains much of the same material found in earlier editions but supplemented with information gained through valuable wartime experience. Most of the new material is contained in a chapter devoted to industrial rehabilitation.

The text includes a survey of the theoretical and practical considerations relevant to various phases of occupational therapy. It includes a concise review of the principles involved in the treatment of orthopedic, surgical, cardiac, tuberculous, and psychiatric patients. The difficult task of boiling down a widely ramifying field of information into one small volume is successfully accomplished.

Although the book is written primarily for the therapist, the physician dealing with any phase of occupational therapy or rehabilitation will find this volume particularly useful regarding details of department organization and administration.

THE DOCTOR'S SCRAPBOOK. By *J. W. Torbett,* Sr., B.S., M.D., F.A.C.P., LL.D. Author of Joytown Jingles and Other Verse; Pastime Poems of a Busy Doctor; Practical Poems for Everyday Use. Cloth. Pp. 256. Price, $2.50. Copyright, 1947, J. W. Torbett, Sr., Marlin, Texas.

The author of this homely and intensely personal narrative became a member of the American Electro-Therapeutic Association in 1901 and served as its president in 1914 and as president of

the State Medical Association of Texas in 1925. He still is an active fellow of the American Congress of Physical Medicine. He has utilized physical medicine in Marlin, Texas, for almost fifty years and later employed balneotherapy on a large scale by developing the local hot mineral springs into a large bath house and sanatorium, now on the list of resorts accepted by the Committee on Resorts of the American Medical Association. Dr. Torbett traveled extensively to medical meetings in the United States and on account of his homespun philosophy and his talent of poetry as well as his seasoned medical knowledge became a much sought after dinner speaker at these meetings. The experiences of his rich life, his gradual rise from a simple Texas farm boy, a son of early Irish immigrants into a popular doctor, philosopher and staunch churchman, are engagingly told in this volume. There are sketches of many of his contemporaries: doctors, politicians, churchmen and simple folk, intertwined with a medley of medical experiences, stories about patients, simple rules of good health as well as much poetry. Photographs of the author's family and of co-workers and the place of work illustrate the book. Reading "The Doctor's Scrapbook" should be of interest to not only Dr. Torbett's numerous friends and patients but also to students of the American Way of Life.

THE PRACTICE OF PHYSICAL MEDICINE. By *Heinrich F. Wolf*, M.D., Consultant, Department of Physical Therapy, Mount Sinai Hospital; formerly Director of the Department of Physical Therapy, Central Neurological Hospital, Welfare Island, New York. Fabrikoid. Pp. 322. Price, $5.00. Chicago, New York, Toronto: Wilcox & Follett Co., 1947.

It seems unfortunate that just at a time when physical medicine is receiving a widespread recognition of usefulness and the importance of a background of fundamental information from research and critical evaluation is being emphasized, another new textbook appears containing so much repetition of old empirical statements and others of doubtful validity. For example some quotations may be cited: ". . . well authenticated fact that cold applications may cause a disease of the kidneys." "Liver stasis in people with a sedentary occupation who do not exercise and who suffer from headache, heaviness and inability to concentrate is quickly relieved by such baths." "Arm and foot baths have been recommended by their advocates for a great many pathological processes, pneumonia, asthma, heart diseases, articular rheumatism, arteriosclerotic gangrene, chronic nephritis. Arthritic conditions in one arm are treated by bathing the other. They reduce the blood pressure materially." "The short sitz bath is useful for stasis of the liver and spleen, atonic constipation, torpid conditions of the pelvis, chronic catarrh of the stomach and intestines, etc." "If we intend to destroy parasitic organisms on the surface of the body by electrical means we use the galvanic current. It makes no difference, of course, what kind of fungi or other parasites we are dealing with or where they are located." "In hemiplegia mild short waves through the head will remove the edema due to regenerative inflammation around the lesion, ease the pressure around the uninjured nerve fibers, and reestablish their function." In subacromial bursitis "long wave diathermy and radiant heat are contraindicated." "Catarrh of the stomach: The acute form is very promptly relieved by the Neptune girdle. In severe cases the combination of the Neptune girdle with the hot coil is preferable." In speaking of poliomyelitis the statement appears that edema "causes a hypertrophy of the connective tissue and neuralgia in the spine; it stimulates the ganglia and a spasm results in the muscles, in the same way that a spasm develops in an old hemiplegia."

In spite of these criticisms there is, of course, much useful information presented, obviously based on years of rich clinical experience. The author's intention of basing treatment on the type of pathologic physiology is also commendable.

Therapeutic exercise which is generally acclaimed as the single physical therapeutic of most importance in the general practice of physical medicine is mentioned only relatively briefly with little detail. Much more attention is given to the use of short wave diathermy in athermic dosage.

This book is not recommended as a teaching text for students or for physicians without a background of knowledge to allow critical judgment of the valuable portions.

PUBLIC HEALTH AND PREVENTIVE MEDICINE, Vol. I and II by *Morton C. Kahn*, Associate Professor of Public Health and Preventive Medicine, Cornell University Medical College, New York City; Co-director Cuban National Anti-Tuberculosis Campaign. Cloth. Pp. Vol. I, 267, Vol II, continuous pagination to 534. Price, $4.00 Set. New York: Oxford University Press, Copyright, 1942.

In two relatively small compact volumes the author has comprehensively summarized the public health problem, its administration and all diseases which are even remotely classified as contagious and communicable.

The author has treated the subject in an eminently satisfactory manner, by dividing the two volumes into three sections, namely; Environmental Sanitation, Transmissible Diseases and Public Health Administration. Under Environmental Sanitation is presented discussion of air, food sanitation, industrial diseases, milk and milk products, refuse disposal, sewage disposal, vitamins, essential amino acids and water. Transmissible Diseases are classified as to grouping in the following manner: Bacterial and Treponema Infections, Virus Infections, Insect-borne Infections (regardless of etiologic agent) and Parasitic Infections. This section is done in a particularly desirable manner, with reference to classification as well as specific etiology, symptomatology, epidemiology, transmission and prevention. Under prevention, the author not only discusses factors of community and personal measures, but brief pertinent comments on treatment.

The section on Public Health Administration is

discussed under that heading (including preschool and school hygiene), Vital Statistics, Quarantine, Maternal and Mortality and Hygiene, Infant Mortality and Hygiene and Hereditary Diseases or Defects.

The treatise is in didactic manner, which, however, seems best for the subject. Each entity is discussed in precise set pattern, pertinent comments made in outline form with complete absence of any semblance of redundancy. The style and contents make for an excellent reference, as well as textbook, although the author states that the latter is not the intention.

The author's stated purpose seems accomplished, namely, in stimulating the medical profession to view not only the patient as a clinical entity, but to view "a nation, a city, a town, and the family in the same light." His presentation stimulates the need of the physician to be community-minded in his practice.

This two volume presentation on Public Health and Preventive Medicine is recommended to the general practitioner and those in specialized fields as well.

THE COMMISSION FOR HANDICAPPED CHILDREN. Reports to the People of Illinois, June, 1941-June, 1946, Illinois Commission for Handicapped Children, 1946.

THE EDUCABLE MENTALLY HANDICAPPED CHILD IN ILLINOIS (Second Edition), Illinois Commission for Handicapped Children, 1946.

PHYSICIAN'S HANDBOOK. By *John Warkentin,* Ph.D., M.D., and *Jack D. Lange,* M.S., M.D. Paper. Pp. 282. Price, $1.50. Fourth Edition. Chicago: University Medical Publishers, 1946.

The purpose of this book has been to summarize tersely, clearly and comprehensively diagnostic procedures and factual data which a physician must have quickly available. At the same time the scope has been extended so as to be a serviceable pocket-reference for many types of medical or dental practice. An effort has been made to include a relatively complete laboratory manual and such other factual information as is more readily forgotten. The section on bacteriology has been thoroughly revised and a new section on mycology has been added. The only mention of physical therapy is a table of wavelengths of the spectral region.

NUTRITION IN PUBLIC HEALTH. By *Lucy Gillett,* M.A. Cloth. Price, $2.75. Pp. 203, with 34 illustrations. W. B. Saunders Co., West Washington Square, Philadelphia 5, 1946.

As stated in the preface the subject of this book has been approached chiefly from the standpoint of the mother or housewife, as one can be of greatest assistance in helping to overcome obstacles which stand in the way of good food habits when these obstacles are seen as they appear to the woman in the home. There are chapters which discuss what children of various ages should eat, about adolescents and adults, the family meals and diets for special conditions. The book is especially recommended for the public health nurse but it also deserves attention from many others.

ANNUAL REVIEW OF PHYSIOLOGY. By *James Murray Luck,* Editor, Stanford University, and *Victor E. Hall,* Associate Editor, Stanford University. Vol 9. Cloth. Price, $6.00. Pp. 736. Stanford University P. O., California: American Physiological Society and Annual Reviews, Inc., 1947.

No book can be more welcome than the appearance of the Annual Review of Physiology. The 1947 edition, volume 9, lives up to its well earned reputation. There are no less than 27 chapters each written by an expert in his field.

Included in the present volume are contributions from Great Britain, New Zealand, Belgium, Denmark and Sweden. Now that World War II is over the appearance of much research that was not accessible for "security" reasons is available for the first time. The chapters of special interest and of greatest value to the physiatrist are those on muscle by Buchthal; exercise by Karpovich; the peripheral circulation by Wiggers; water metabolism by Adolph; the physiologic effects of heat and cold by Gagge and Herrington; nerve and synaptic conduction by Bremer; bioelectric potentials in the nervous system and in muscles by Grundfest; the experimental neurosis by Liddell; and permeability by Wilbrandt. This is only a sample of the rich feast presented. This volume is a must for those interested in physical medicine as well as the general practitioner.

MEDICAL RESEARCH, A SYMPOSIUM. Edited by *Austin Smith,* M.D. Cloth. Pp. 169, with 17 illustrations. Price, $5.00. Philadelphia: J. B. Lippincott Co., 1946.

Here is medical research revealed with the candid perception of key men in the field. This absorbing book provides the answers on medical research. It gives a background for the understanding of medical research. It explains how research money is used. It expounds the needs that exist and the methods by which these needs can be met.

Medical research is presented as a cycle of continuous planning, questioning and testing so that man can obtain the answers to the ever-present questioning words — what, how, why and when. Modern research is not something pursued by a man or woman working alone. Today, research is something sought by many who are joined in spirit and in work and who make no pretense of working alone.

All phases of research are discussed by contributors with special interest and wide experience in their topics. They trace the fascinating development of medical research from its philosophic point of view, through laboratory and clinical trials, production and publicizing. They present the role and inter-relation of all particiupants in medical research, the objectives, obligations and purposes of their work. It should be read by all research workers.

PHYSICAL MEDICINE ABSTRACTS

Peroneal Palsy Caused by Crossing the Legs. Simon H. Nagler, and Leo Rangell.

J. A. M. A. **133**:755 (March 15) 1947.

Of the peripheral nerves closest to the surface, least protected and most vulnerable to both acute and chronic trauma, the common peroneal nerve ranks high. Thus, Wilson places it second only to the musculospiral and ulnar nerves for frequency of damage, while it stands first in Cassirer's series of over 1,000 cases.

Sitting with the legs crossed, a ubiquitous habit in modern man, is strikingly brought out as a common factor in producing the symptoms referable to the peroneal nerve in our observed cases. This habit, particularly prevalent in men, has been described a few times before as a factor in the production of peroneal palsy, but has for the most part been overlooked and neglected as a casual agent in this condition.

A few final words in regard to therapy are in order. By prompt recognition and removal of the causal factors in a case of peroneal palsy due to crossing the legs, one can prevent serious neural damage. Mechanical support of the foot, radiant heat, galvanism and adequate nutrition with large doses of thiamine chloride were utilized. The therapeutic results were good.

Eight cases are reported of unilateral peroneal palsy occurring in healthy military personnel.

A common causal factor present in all 8 cases was the chronic habit of sitting with the legs crossed, which is shown to result, in persons of asthenic habitus, in a compression neuritis of the common peroneal nerve of the uppermost leg. This may either result in symptoms or may merely sensitize the nerve to other causal agents.

Another important causal factor in the reported cases was the assumption of various occupational positions incident to military duties and traumatic to the common peroneal nerve.

Compound Injuries of the Knee Joint. Study 1 — Treatment of Noninfected Knee Joints. Joe M. Parker, and John J. Modlin.

Ann. Surg. **125**:341 (March) 1947.

The keynotes in the after care of clean wounds of the knee are: First, the initiation of proper exercises as early as the first day after secondary suture of the skin to prevent quadriceps atrophy; and, second, the early mobilization of the joint to prevent the formation of adhesions that would restrict the range of motion. The latter is important where the synovium has been destroyed at its lateral and medial reflections. For these reasons, the thoroughness of the initial care, aimed at preventing suppuration and smoothing articular defects, is probably the one most important phase in the proper care of compound injuries of the knee.

Low Back Pain: A Different Cause and Treatment. The Pronation Syndrome. Laurence Jones.

Indust. Med. **16**:57 (Feb.) 1947.

There is a great diversity of opinion as regards almost every aspect concerned with acute and chronic low back pain. In spite of this variance, the subject of this paper advances a different approach.

A considerable mass of clinical material, most of it representing experiences of the past four years, is presented to indicate that a variety of other symptoms in addition to those of low back pain can be caused by an exceedingly common type of faulty foot posture; namely, pronation or internal rotation of the feet.

Since all of these symptoms may have one cause, this complex has been termed the Pronation Syndrome. Evidence of various kinds are presented to indicate that this primary pronation or internal rotation of the feet produces secondary anatomical postural changes in the structures above, which, in turn produce multiple deviations in various weight-bearing lines. Some of these are demonstrable clinically by observation. Others, such as changes in the pelvic and spinal alinement can not only be demonstrated in serial radiographs, but the differences are also sufficient to be capable of actual measurement. From the diagnostic standpoint the presence of the syndrome should be suspected when confronted by one or all of four cardinal symptoms. These are: generalized fatigue, dull leg aches of various distributions, low back pain of various patterns and sciatic neuritis or sciatica.

The Effect of Limb Position in Seated Subjects on Their Ability to Utilize the Maximum Contractile Force of the Limb Muscles. P. Hugh-Jones.

J. Physiol. **105**:332 (Jan. 15) 1947.

It is well known that human muscles in maximum contraction exert a large force in the line of the tendon, often exceeding 1,000 pounds, and that this force is dependent on the initial length of the muscle as shown by Evans and Hill, Reijs, and others. In everyday life these forces are not noticed, for the muscles work at a mechanical disadvantage, usually of about 10:1, which gives a high gear-ratio and allows rapid movement. The precise mechanical disadvantage is dependent on the angle of the acting joint and this finally determines the force which can be exerted.

An account is given of experiments designed to determine how the maximum pull or push exertable on an isometric hand control, and the maxi-

mum push exertable on an isometric foot-pedal, vary with different control positions relative to a seat. It is shown that, in general, push or pull increases with extension of the acting joint until a maximum is reached just before the joint becomes straight.

For pushing on a control, against a seat back-rest, the findings agree with the theory that the limb acts as a mechanical "toggle" between the control and the back-rest. This toggle-action markedly increases the exertable push, and the relationship between control and seat becomes highly critical; it was found that the action is stopped at a well-defined "limiting angle" and that the effect was more pronounced in the lower limb. The "limiting angles" found were 160 degrees for knee- extension and, approximately, 135 degrees for elbow-extension.

For an isometric foot-pedal placed in front of a seat, maximum push is attainable when the subject's thigh is about 15 degrees to the horizontal and his knee is extended just to reach the limiting angle. In this position mean maximum efforts for three different, selected, groups of subjects were 845 ± 35 pound (6), 691 ± 66 pound (32), and 689 ± 62 pound (16).

For an isometric hand-lever, maximum pull or push is attainable when the elbow is extended up to the limiting angle, the hand-grip is about at elbow height for the seated subject, and the lever moves in a vertical plane which passes through the shoulder-joint.

To exert pressure between an isometric hand-grip and a seat back-rest is subjectively unpleasant, though the exertable push, owing to toggle-action, is greater than the pull under comparable conditions. For reasons given, it is concluded that the conventional "pull-on" hand-brakes for vehicles are preferable to a "push-on" variety.

Edema or Herniations of Fat Lobules as a Cause of Lumbar and Gluteal "Fibrositis." W. S. C. Copeman, and W. L. Ackerman.

Arch. Int. Med. 79:22 (Jan.) 1947.

Fibrositis as a clinical entity has long been accepted in England, where it constitutes about 12 per cent of all medical cases seen. It has always been recognized, however, that its pathologic foundations are slender, resting as they do almost entirely on the theories of Gowers and the observations, comparatively few in number, of Stockman at the beginning of this century.

A systematic study of fibrositis of the lumbar and gluteal regions has been made in a body of picked men. The pain has been studied clinically and the authors have confirmed the occurrence of localized "trigger points" from which pain in this condition may be widely referred. The exact situation in which these occurred in a series of patients was charted and a "pain pattern" of definite shape resulted.

Previous observation that these points may arise during any pyrexial illness, or as the result of trauma, was confirmed; also that the subjective pain often disappears, but that the point remains and can be detected by its tenderness on palpation. It can be reactivated subsequently and may gradually become the seat of chronic pain.

The back was carefully dissected in 14 bodies with particular reference to the sites at which pain had chiefly been found to occur. It was found that a "basic fat pattern" was constantly present, even in the most cachectic subjects, in whom all other fat was absent. This "fat pattern" was observed to correspond with the "pain pattern" already charted, in situation and shape.

Observations show that the production of pain at these trigger points takes place in certain fibrofatty tissue and not in the muscles, as has often been stated. The local lesion demonstrated in those cases in which biopsy was performed consisted of an increase in the volume of certain fat lobules in situations where expansion was normally limited by an unyielding fibrous capsule. In one case this increased tension in the lobule appeared to be the result of an old hematoma.

In the clinical cases described in this paper this process had progressed further and actual herniation of these lobules had occurred through weak spots in the fibrous compartment or capsule. The causative nature of these lesions seemed to be confirmed by the patient's freedom from pain subsequent to the removal of the herniations.

Exploration of the painful area in a small series of cases of periarticular fibrositis ("panniculitis") of the menopausal type suggested that a similar mechanism might also be responsible for the pain in these cases.

Physiologic principles underlying certain lines of physical treatment commonly employed in the treatment of fibrositis are shown to be rational for the pathologic conditions described.

Bismuth Therapy and Physiotherapy in Rheumatoid Arthritis. J. Shulman.

Brit. J. Phys. Med. 10:8 (Jan.-Feb.) 1947.

The organization of a physical medicine department in a provincial general hospital demands, amongst other things, the management of an apparently endless stream of sufferers from all the rheumatic diseases, ranging from "Still's" disease in the young, through rheumatoid arthritis and spondylitis ankylopoetica in the young adult, to gout, fibrositis and menopausal arthritis in middle life and finally to all stages of degenerative osteoarthritis in the elderly. It is not implied that these age groups are consistent in their rheumatic diseases relation, but they do give a rough basis of the major frequencies within the groups.

Until the advent of gold therapy, in rheumatoid arthritis there was little else in the way of active therapy except endless treatments by heat radiations, actinotherapy, ionization, diathermy, massage, movements and other physical adjuncts, together with orthopedic supports to prevent and correct deformity.

So eagerly has gold been accepted as the specific for rheumatoid arthritis that, despite its high percentage of toxity, little else has been found to replace it, in spite of the rival claim of bismuth.

Douthwaite in 1944 made a cautious investigation into the possibilities of bismuth in the treatment of rheumatoid arthritis, particularly because it has the advantage of being less toxic than gold.

In cases of rheumatoid arthritis in which the general condition is reasonably good and the blood count is reasonably normal, it has been found that better results are obtained by combining the administration of bismuth with ion transfer to the affected joints. A 1 per cent solution of "T. C. P." (trichlorophenylmethyliodosalicyl) is ionized into the tissues of the affected region for sixty to one hundred milliampere hours, thus introducing ions of chlorine, iodine and salicylate into the area.

Fibromyositis, Including Its Industrial Implications and Special Reference to Referred Pain. F. W. Slobe.

Occup. Med. **2**:329 (Oct.) 1946.

Slobe asserts that ailments classed under the broad grouping of "fibromyositis" are among the commonest diseases of adults. They are neither confined nor peculiar to industry. Their industrial significance arises from the frequency of involvement among the age groups employed in industry, the frequency of actual or alleged association with strains, sprains, contusions, continued exertion and minor repetitive motions, the vast number of lost work days and the huge amount of impaired efficiency caused by these ailments. The author defines fibromyositis as a localized (occasionally diffuse) area of infiltration. The causation is not known. Referred pain and tenderness are frequent manifestations and are likely to cause errors in diagnosis. Characteristics of referred pain from the four most frequent sites of origin are described, namely, the dorsolumbar region, the lower part of the back, the shoulder girdle and upper dorsal region and the cervical region.

Adhesive Strapping for Low Back Pain. H. J. Schaubel.

J. Michigan M. Soc. **45**:1492 (Nov.) 1946.

Schaubel employed an adhesive support supplemented with tongue blade splints for the treatment of low back pain and low back injuries which require temporary immobilization.

Rural Service and "Shoveler's Disease" (Avulsion of Spinal Processes). E. Wetzel.

Schweiz. med Wchnschr. **76**:990 (Sept. 28) 1946.

Wetzel directs attention to the occurrence of avulsions of the spinal processes in the course of exertions, such as pitching in farm work, by persons who are unaccustomed to hard physical labor. To illustrate this so-called shoveler's disease he presents the case of a youth, aged 18, a copper-engraver by trade, in whom avulsion of a spinal process (seventh cervical) took place while he was engaged in farm work. His complaint was pain between the shoulder blades. There was sensitivity to pressure in this region, and forward, and sideward lifting of the arms caused pains. Such patients should refrain from the exertion that caused the avulsion for about four weeks.

Radioactive Iodine in Study of Thyroid Physiology: VII. Use of Radioactive Iodine Therapy in Graves' Disease. S. Hertz, and A. Roberts.

West. J. Surg. **54**:474 (Dec.) 1946.

The present paper by Hertz and Roberts in a three to five year follow-up report on early experiences with "internal irradiation" in the treatment of 29 cases of hyperthyroidism. Analysis of both failures and successes reveals that radioactive iodine when given in the dosage range of 5 to 25 millicuries to uniodinized patients with hyperthyroidism possessing goiters of 60 to 75 Gm. is highly effective in about 80 per cent of cases. When appreciable activity has been administered and subtotal thyroidectomy is resorted to, myxedema or hypometabolism may be expected to develop in a large fraction of the cases (100 per cent in 5 cases in this series).

Roentgen Treatment of Bursitis of Shoulder. B. R. Young.

Am. J. Roentgenol. **56**:626 (Nov.) 1946.

Young says that the results obtained with roentgen therapy in 87 patients with bursitis of the shoulder indicate that it is a valuable form of treatment for cases manifesting acute and subacute forms of the disease. All but 2 of the patients with acute bursitis were relieved of pain, and the majority were well in one week or less. The responses in the subacute group were not as prompt, but more than two-thirds reported complete relief of pain in two weeks or less and only a few were not benefited. Only one-third of the group with chronic symptoms were cured, and almost 50 per cent reported no relief of pain.

Disability Resulting From Injuries to Peripheral Nerves. James S. Ellis.

Brit. J. Phys. Med. **10**:2 (Jan.-Feb.) 1947.

In war-time, injuries to peripheral nerves are common and produce a great deal of disablement.

An attempt has been made to show that severe injuries to the major nerves of the limbs do not necessarily bar the patient from useful work. Treatment can go a long way towards lessening the ultimate disability. The patient's intelligent cooperation and interest can prevent the long and tedious waiting from becoming insufferable. Appreciation by the employer of a man's disabilities, as well as of his abilities, is essential if the wounded man is to regain a useful and profitable life. Throughout the whole time, from wounding to resettlement in industry, patient, surgeon and employer must together ensure the satisfactory result which is possible in the majority of these cases.

AMERICAN REGISTRY OF PHYSICAL THERAPY TECHNICIANS

30 North Michigan Avenue — Chicago 2, Illinois

1947 DIRECTORY

"Jr." appearing in parenthesis following a name designates a junior physical therapy technician. A junior technician is a person with limited training in physical therapy but who has had a minimum of high school training and four years acceptable physical therapy experience. Registration in this class was closed Dec. 31, 1939. All others are senior physical therapy technicians. Only graduates of courses approved by the Council on Medical Education and Hospitals are eligible for application for registration. A list of these approved courses may be obtained by writing the American Medical Association, 535 North Dearborn Street, Chicago 10.

June, 1947 — MARION G. SMITH, Registrar.

A

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(Continued on page 422)

Certificate of Compliance

with

RULES AND REGULATIONS, FEDERAL COMMUNICATIONS COMMISSION
GOVERNING MEDICAL DIATHERMY EQUIPMENT
Part 18 — Section 18.11

by

AMERICAN

The undersigned manufacturer certifies that in the light of the following information and such other investigation as may be required by good engineering practice, the equipment described in this certificate may be reasonably expected to meet the requirements of Federal Communications Commission Part 18, Section 18.11 rules and regulations relating to the operation of Medical Diathermy equipment, when operated under the conditions set forth below, for a period of at least five years.

TECHNICAL DATA:

a. Frequency—27.32 Mc + .05%.
d. Maximum power output 500 watts (lamploaд test and non-inductive resistapce load (I^2R) method of measurement).
c. Maximum plate-power input, Final Amplifier: 700 watts.
d. Frequency control: Piezo-electric quartz crystal and necessary components.
e. Spurious and harmonic radiation: Guaranteed not to exceed 10 microvolts per meter on any radius at a distance of 1,000 feet or more from the medical diathermy emitter.

OPERATING CONDITIONS:

This equipment may be operated under all normal conditions required of medical diathermy application and with all accepted types of applicators and technique including applicator pads, air-space plates, cuffs, inductor cable and drum and electro-surgery. All adjustments for applicator-patient resonance and power output must be made by means of the controls provided on the instrument panel and/or by proper arrangement of the applicators.

TEST DATA:

1. Between 50° and 100° F the ambient temperature in the cabinet at which the maximum frequency deviation occurs over a treatment cycle is 87° F. This deviation is minus 2.72 K.C. at carrier frequency.
2. The long-time frequency stability, i.e. the frequency stability guaranteed by the manufacturer under the above operating conditions for five years, is ± .05%.
3. Measuring equipment used for this certification of frequency stability and measurement consists of General Radio secondary frequency standard, correlated with standard time signals (WWV).
4. F.C.C. type approval for this equipment will be obtained at such time as F.C.C. has promulgated the standards of good engineering practice and announced its readiness to make type-approval tests.

4A—F.C.C. Type-Approval Number.....

4B—Department of Transport, Radio Division (Canada) Type Approval Number.....

DIATHERMY EQUIPMENT:

Type XC500

Serial No. .....

AMERICAN DIATHERMY PRODUCTIONS

Dated .....

By.....

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LOS ANGELES 25, CALIFORNIA

Twenty-Fourth Annual Conference

American Physiotherapy Association

Asilomar, Pacific Grove, California—July 6 to 12, 1947

Program Schedule

	Sunday July 6	*Monday July 7*	*Tuesday July 8*	*Wednesday July 9*	*Thursday July 10*	*Friday July 11*	*Saturday July 12*
8:30 a.m.		House of Delegates and General Session Address: Sue Roen, President Annual Reports to Membership Election of Officers of House of Delegates	James B. Mennel, M.D. "Massage"	FUNCTIONAL ANATOMY: Chairman. Lucille Daniels Verne T. Inman, M.D. Prof. of Anatomy, Univ. of Calif. "Functional Anatomy of the Lower Extremity"	Verne T. Inman, M.D. "Functional Anatomy of the Lower Extremity"	Verne T. Inman, M.D. "Functional Anatomy of the Lower Extremity"	9:00 A. M. James B. Mennell, M.D. "Phases of Therapeutic Exercise"
10:30 a.m.			House of Delegates and General Session	Irving Rehman, Ph.D., Asst. Prof. of Anatomy, Univ. of Southern Calif. "Normal Joint Motions of the Lower Extremity"	Chas. L. Lowman, M.D., Chief of Staff, Orthopaedic Hospital, Los Angeles "Correction of Gluteus Medius Limp"	Signe Brunnstrom, M.A., A.P.A. "Gait Training Procedures"	11:00 A. M. Discussion period
12:30 p.m.	Luncheon						
2:00 p.m.	Registration* P.T. Schools Section	REHABILITATION: Chairman, Hazel Furscott History of Rehabilitation Relation of Medical Service to Rehabilitation Services Mental Hygiene in Relation to Rehabilitation Testing Procedures	*Physical Therapy Technics in Rehabilitation* Physical Demands of Daily Life Group Exercises and Games as Therapeutic Treatment Physical Therapy Procedures in Preoperative and Postoperative Care of Chest Surgery Patients Early Bed Exercises Demonstrations of Remedial Exercise	*Correlated Fields* Occupational Therapy Rehabilitation Placement of the Handicapped Vocational Rehabilitation Services	Tours of the Monterey Peninsula Arranged by Northern California Chapter	House of Delegates and General Session	
5:00 p.m.	Exhibits	Exhibits	Exhibits	Exhibits	Barbecue Supper	Exhibits	
6:00 p.m.	Dinner						
7:30 p.m.	P.T. Schools Section	Meetings of National and Chapter Standing Committee Chairmen: Education Legislation Relations		House of Delegates and General Session	Entertainment	House of Delegates and General Session.	

*Registration fee: Members, $5.00; nonmembers, $10.00; students, $2.00.

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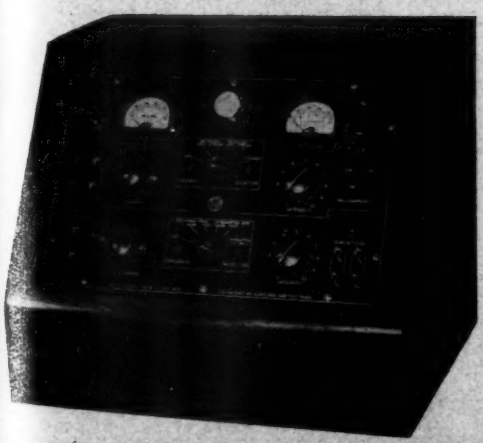

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